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FLOBOSS™ 407 FLOW MANAGER

Instruction Manual

Flow Computer Division

EMERSON Process Management

Website: www.EmersonProcess.com

Revision Tracking Sheet

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This manual may be revised periodically to incorporate new or updated information. The date revision level of each page is indicated at the bottom of the page opposite the page number. A major change in the content of the manual also changes the date of the manual, which appears on the front cover. Listed below is the date revision level of each page.

Page	**Revision**
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All	Dec/03
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Table of Contents

SECTION 1 – GENERAL INFORMATION

1.1 Scope of Manual

This manual describes the FloBoss™ 407 Flow Manager and includes all versions of FloBoss units including the standard version and the Industry (Measurement) Canada custody transfer version. For software aspects, such as configuration, refer to the respective software configuration user manual.

❖ **NOTE:** Certain hardware versions and functionality may require higher revisions of ROCLINK™ configuration software. Verify the version of configuration software.

1.2 Manual Contents

This section contains the following information:

Section 2 – Functionality, Wiring Built-in I/O, Wiring the FloBoss, and Troubleshooting provides information and specifications concerning the two main components of the FloBoss 407, the processor board and the termination board, wiring built-in inputs, main power wiring, and troubleshooting.

Section 3 – Input/Output Modules provides information and specifications for the optional I/O modules.

Section 4 – Communications Cards provides information and specifications for the communications card options.

Section 5 – Display and Keypad describes the operation of the Keypad, display, and specifications.

Appendix A – Lightning Protection Module describes the optional LPM and specifications.

Appendix B – Multi-Variable Sensors describes the optional MVS and specifications.

Appendix C – I/O Simulation shows various ways to set up I/O simulation for troubleshooting I/O components and configurations.

For more information on software or accessories, please refer to the following manuals.

- *ROCLINK for Windows Configuration Software User Manual* (Form A6091) – ROCLINK for Windows software Version 1.01 or greater is required for all FloBoss 407 units Version 1.08 or less.
- *ROCLINK 800 Configuration Software User Manual* (Form A6121) – ROCLINK 800 Version 1.20 or greater is required for all FloBoss 407 units with Version 1.08 firmware or greater.
- *ROC/FloBoss Accessories Instruction Manual* (Form A4637) – Provides information concerning accessories, such as Resistance Temperature Detector (RTD) sensors for the Multi-Variable Sensor (MVS).

1.2.1 FCC Information

This equipment complies with Part 68 of the Federal Communications Commission (FCC) rules. On the modem assembly is a label that contains, among other information, the FCC certification number and Ringer Equivalence Number (REN) for this equipment. If requested, this information must be provided to the telephone company.

A FCC compliant telephone modular plug is provided with this equipment. This equipment is designed to be connected to the telephone network or premises' wiring, using a compatible modular jack that is Part 68 compliant. See Installation Instructions for details.

The REN is used to determine the quantity of devices that may be connected to the telephone line. Excessive RENs on the telephone line may result in the devices not ringing in response to an incoming call. Typically, the sum of the RENs should not exceed five (5.0). To be certain of the number of devices that may be connected to a line (as determined by the total RENs), contact the local telephone company.

If this equipment, dial-up modem, causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice is not practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it necessary.

The telephone company may make changes to its facilities, equipment, operations or procedures that could affect the operation of the equipment. If this happens the telephone company will provide advance notice so you can make the necessary modifications to maintain uninterrupted service.

If trouble is experienced with this equipment, dial-up modem, for repair or warranty information, please contact Emerson Process Management, Flow Computer Division (641) 754-2578. If the equipment is causing harm to the telephone network, the telephone company may request that you disconnect the equipment until the problem is resolved.

1.3 Product Overview

The FloBoss 407 is a microprocessor-based flow computer (Figure 1-1) that provides functions required for gas flow measurement and custody transfer in accordance with standards, such as AGA 1985 or 1992 orifice metering. The FloBoss provides on-site functionality for applications where there is a need for remote monitoring, measurement, data archival, communications, and control. The design allows you to configure the FloBoss 407 for specific applications including those requiring calculations, logic, and sequencing control using Function Sequence Tables (FST), as well as Proportional, Integral, and Derivative (PID) loop control.

The FloBoss 407 is available in two versions based on the type of approval: the standard hazardous area version, and the Measurement (Industry) Canada custody transfer version, which includes hazardous area approval. These versions have a number of differences both in firmware and hardware. Both of these versions are further subdivided by the type of orifice metering calculations (either AGA 1992 or AGA 1985) included in the firmware along with AGA7 turbine metering calculations.

Figure 1-1. FloBoss 407 Flow Manager

Physically, the FloBoss 407 consists of two printed circuit cards, a Keypad, and a display housed in a compact weather-tight case. The printed circuit cards are the processor board (mounted on the door) and the termination board (mounted in the main enclosure).

Built into the termination board are two Analog Input (AI) channels. Moving jumper P4 on the termination board changes one of the built-in Analog Inputs to a Pulse Input (PI). The Pulse Input can be wired either as a FloBoss-powered or a device-powered, medium-speed pulse counter. The pulse circuitry is optically coupled to isolate the termination board from the input signal.

In addition, the termination board has slots for four plug-in input/output (I/O) modules (modular I/O). The plug-in I/O modules allow any combination of Discrete Inputs, Discrete Outputs, Analog Inputs, Analog Outputs, or Pulse Inputs that an application requires.

❖ **NOTE:** I/O modules must not be used as flow inputs for Industry Canada approved FloBoss units.

The built-in Liquid Crystal Display (LCD) and membrane Keypad provide the ability to view data and configuration parameters while on site. The Keypad also permits limited editing of parameter values.

The FloBoss 407 can have up to four Multi-Variable Sensor (MVS) devices connected to it, one of which can be an Integral MVS. The MVS provides the differential pressure, static pressure, and temperature inputs required for performing orifice flow calculations. The Integral MVS is factory-mounted to the bottom of the enclosure with a coupler and further secured with a stiffening plate. For detailed information on the MVS, refer to Appendix B and the *ROC/FloBoss Accessories Instruction Manual* (Form A4637).

The FloBoss has two communication ports built in: a local operator interface (Local Port) and an EIA-232 (RS-232) serial port (COM1). A variety of optional plug-in communication cards are available that allow you to add another communications channel (COM2): EIA-232 (RS-232) serial, EIA-422/485 (RS-422/485) serial, dial-up modem, radio modem, or leased-line modem communications.

The FloBoss 407 is housed in a National Electrical Manufacturer's Association (NEMA) 4X windowed enclosure that can mount on a wall or a 2-inch pipestand. The enclosure, which protects the electronics from physical damage and harsh environments, is fabricated of die-cast, low-copper aluminum alloy. It consists of four pieces: the body, the electronics cover, the Keypad cover, and the lower cover. Silicone-rubber gaskets seal the FloBoss when the covers are closed. All covers are secured by captive screws.

Note that for the Measurement Canada version of the FloBoss 407, the electronics cover, and the lower cover are secured by special captive screws. These screws have holes through the heads for adding security wire seals according to Measurement (Industry) Canada requirements.

For the standard version of the FloBoss 407, an optional padlock adapter can be added in the field. This adapter is installed on the captive screw that secures the electronics cover. With the shank up to 6.35 millimeters (0.25 inches) diameter of the padlock running through the adapter, the screw is inaccessible and the cover cannot be opened.

1.4 Installation Guidelines

This manual provides generalized guidelines for successful installation and operation of the FloBoss 407. Planning helps to ensure a smooth installation. Be sure to consider location, ground conditions, climate, and site accessibility, as well as the suitability of the FloBoss 407 application while planning an installation.

❖ **NOTE:** Use a standard screwdriver with a slotted (flat bladed) 1/8" width tip when wiring all terminal blocks.

1.4.1 Environmental Requirements

The FloBoss 407 case is classified as a National Electrical Manufacturer's Association (NEMA) 4X enclosure. This provides the level of protection required to keep the FloBoss operating under conditions, such as harsh weather and corrosive atmospheres.

❖ **NOTE:** In salt spray environments, it is especially important to ensure that the enclosure is sealed properly, including all entry and exit points. If salt is allowed to enter, it can shorten the life of the lithium battery in the FloBoss and cause the battery to leak corrosive chemicals.

The FloBoss is designed to operate over a wide range of temperatures, as detailed in the Environmental specifications. Outside of this range, it may be necessary to moderate the temperature in which the FloBoss operates.

1.4.2 Site Requirements

Careful consideration in locating the FloBoss 407 on the site can help prevent future operational problems. The following items should be considered when choosing a location:

- Local, state, and federal codes often place restrictions on monitoring locations and dictate site requirements. Examples of these restrictions are fall distance from a meter run, distance from pipe flanges, and hazardous area classifications.
- Locate the FloBoss to minimize the length of signal and power wiring. By code, line power wiring must not cross meter runs.

- Orient solar panels used with solar-powered FloBoss units to face True South (not magnetic) in Northern hemispheres. Orient solar panels used with solar-powered FloBoss units to face True North (not magnetic) in Southern hemispheres. Make sure nothing blocks the sunlight from 9:00 AM to 4:00 PM.
- Antennas for FloBoss units equipped for radio communications, must be located with an unobstructed signal path. If possible, locate antennas at the highest point on the site and avoid aiming antennas into storage tanks, buildings, or other tall structures. Allow sufficient overhead clearance to raise the antenna.
- To minimize interference with radio communications, locate the FloBoss away from electrical noise sources, such as engines, large electric motors, and utility line transformers.
- Locate the FloBoss away from heavy traffic areas to reduce the risk of being damaged by vehicles. However, provide adequate vehicle access to aid in monitoring and maintenance.

1.4.3 Compliance with Hazardous Area Standards

The FloBoss 407 has hazardous location approval for Class I, Division 2, Groups A, B, C, and D exposures. The class, division, and group terms are defined as follows:

Class defines the general nature of the hazardous material in the surrounding atmosphere. Class I is for locations where flammable gases or vapors may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Division defines the probability of hazardous material being present in an ignitable concentration in the surrounding atmosphere. Division 2 locations are presumed to be hazardous only in an abnormal situation.

Group defines the hazardous material in the surrounding atmosphere. Groups A to D are defined as follows:

- Group A – Atmosphere containing acetylene.
- Group B – Atmosphere containing hydrogen, gases, or vapors of equivalent hazards.
- Group C – Atmosphere containing ethylene, gases, or vapors of equivalent hazards.
- Group D – Atmosphere containing propane, gases, or vapors of equivalent hazards.

For the FloBoss 407 to be approved for hazardous locations, it must be installed according to the National Electrical Code (NEC) Article 501.

⚠ CAUTION

When installing units in a hazardous area, make sure all installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous. Installation in a hazardous area could result in personal injury or property damage.

❖ **NOTE:** Measurement Canada approved units normally require a sealed installation. Refer to your local codes for specifics.

1.4.4 Power Installation Requirements

Typical sources of primary power for FloBoss 407 installations are line power and solar power. Care must be taken to route line power away from hazardous areas, sensitive monitoring devices, and radio equipment. Local and company codes generally provide guidelines for line power installations. Adhere rigorously to all local and National Electrical Code (NEC) requirements for line power installations.

Solar power allows installation of the FloBoss 407 in locations where line power is not available. The two important elements in a solar installation are solar panels and batteries. Each must be properly sized for the application and geographic location to ensure continuous, reliable operation. Information contained in the *ROC/FloBoss Accessories Instruction Manual* (Form A4637) can help you determine the solar panel and battery requirements to fit your installation.

As a site may have additional power requirements for radios, repeaters, and other monitoring devices, the Flow Computer Division of Emerson Process Management offers power supply and converter accessories to minimize the number of separate power sources required for an installation.

1.4.5 Grounding Installation Requirements

Grounding wiring requirements for line-powered equipment are governed by the National Electrical Code (NEC). When the equipment uses line power, the grounding system must terminate at the service disconnect. All equipment grounding conductors must provide an uninterrupted electrical path to the service disconnect.

> The National Electrical Code Article 250-83 (1993), paragraph c, defines the material and installation requirements for grounding electrodes.
>
> The National Electrical Code Article 250-91 (1993), paragraph a, defines the material requirements for grounding electrode conductors.
>
> The National Electrical Code Article 250-92 (1993), paragraph a, provides installation requirements for grounding electrode conductors.
>
> The National Electrical Code Article 250-95 (1993) defines the size requirements for equipment grounding conductors.

Proper grounding of the FloBoss 407 helps to reduce the effects of electrical noise on the units operation and protects against lightning. Lightning Protection Modules (LPM) are available to provide additional lightning protection for field wiring inputs and outputs. A surge protection device installed at the service disconnect on line-powered systems offers lightning and power surge protection for the installed equipment.

All earth grounds must have an earth to ground rod or grid impedance of 25 ohms or less as measured with a ground system tester. The grounding conductor should have a resistance of 1 ohm or less between the FloBoss 407 case ground lug and the earth ground rod or grid.

The grounding installation method for the FloBoss 407 depends on whether the pipeline has cathodic protection. On pipelines with cathodic protection, the FloBoss 407 must be electrically isolated from the pipeline.

Electrical isolation can be accomplished by using insulating flanges upstream and downstream on the meter run. In this case, the FloBoss 407 could be flange mounted or saddle-clamp mounted directly on the meter run and grounded with a ground rod or grid system.

Another way of providing electrical isolation would be to mount the FloBoss 407 on a pipestand and use a Remote Multi-Variable Sensor installed with non-conductive conduit. Ground the case of the FloBoss 407 to a ground rod or grid system.

On pipelines without cathodic protection, the pipeline itself may provide an adequate earth ground and the FloBoss 407 could mount directly on the meter run. Test with a ground system tester to make sure the pipeline to earth impedance is less than 25 ohms. If an adequate ground is provided by the pipeline, do not install a separate ground rod or grid system. All grounding should terminate at a single point.

If the pipeline to earth impedance is greater than 25 ohms, the FloBoss 407 installation should be electrically isolated and a ground rod or grid grounding system installed.

1.4.6 I/O Wiring Requirements

I/O wiring requirements are site and application dependent. Local, state, or NEC requirements determine the I/O wiring installation methods. Direct burial cable, conduit and cable, or overhead cables are options for I/O wiring installations. Sections 2 and 3 contain detailed information on connecting I/O wiring to the FloBoss 407.

1.5 Power Supply Requirements

The power consumption of a FloBoss 407 system determines power supply and battery sizing for both line and solar power supplies. Table 1-1 and Table 1-2 provide information to assist in determining power requirements.

1.5.1 Determining I/O Channel Power Consumption

To determine the I/O Channel Power:

1. Calculate the **Duty Cycle** of each I/O channel and enter the values in Table 1-1.

   In estimating total I/O power requirements, the Duty Cycle of each I/O channel (built-in I/O or modular I/O) must be estimated.

   For a non-analog I/O channel, the Duty Cycle is the percentage of time that the I/O channel is active (maximum power consumption). For example, if a Discrete Output is active for 15 seconds out of every 60 seconds, the Duty Cycle is:

   Duty Cycle = Active time ÷ (Active time + Inactive time) = 15 sec ÷ 60 sec = 0.25

   ❖ **NOTE:** For non-analog I/O, size the I/O module scaling resistors for optimal current to minimize current drain on the power supply.

   For an analog I/O channel, the Duty Cycle is approximated by estimating the percentage of time the channel spends in the upper half of its range (span) of operation. For example, if an Analog Input wired as a current loop (4 to 20 milliamps) device operates in the upper half of its range 75% of the time, then 0.75 would be used as the Duty Cycle. If the analog channel generally operates around the midpoint of its span, use 0.5 as the Duty Cycle.

2. To calculate the total power consumed by an I/O channel, first select either the **12 Volt** or **24 Volt** column in Table 1-1 or Table 1-2 and read the minimum (**P_{min}**) and maximum (**P_{max}**) power consumption value from the table for the desired I/O channel.

3. Calculate the power consumption for a channel with the Duty Cycle using the following equation taken into account:

$$\text{Power} = (P_{max} \times \text{Duty Cycle}) + [P_{min} (1 - \text{Duty Cycle})]$$

4. Multiply this value by the quantity (**QTY**) of I/O channels with the same Duty Cycle and enter the calculated value in the **Sub-Total** column.
5. Repeat the procedure for all other I/O channels used.
6. Total the values in the **I/O Modules Sub-Total** column in Table 1-2.
7. Enter the **I/O Modules Total** value in Table 1-1.
8. **Calculate** the **Radio Power Consumption** total. Refer to Section 1.5.2, Determining Radio Power Consumption, on page 1-9.
9. Enter the **Radio Power Consumption Total** value in Table 1-1.
10. Calculate **Total** power consumption in Table 1-1.
11. **Add** the **power consumption** (in mW) of any **other devices** used with the FloBoss in the same power system, but not accounted for in the tables to the Total power consumption value in Table 1-1. Refer to Section 1.5.3, Totaling Power Requirements, on page 1-10.

Table 1-1. Power Consumption of the FloBoss 407 and Powered Devices

Device	Power Consumption (mW)				QTY	Duty Cycle	Sub-Total (mW)
	12 Volt		24 Volt				
	P_{min}	P_{max}	P_{min}	P_{max}			
Processor and I/O Termination Board (includes minimum built-in I/O power consumption)	N/A	800	N/A	1200	1	N/A	
Built-in Analog Input – FloBoss-Powered Current Loop	130	440	130	440			
Built-in Analog Input – Externally-Powered Voltage Signal	0	65	0	275			
Built-in Pulse Input – FloBoss-Powered	0	12	0	24			
Built-in Pulse Input – Externally-Powered	0	0	0	0			
Serial Communications Card	135		135			N/A	
Dial-up Modem Communications Card	395		395			N/A	
Leased-Line Communications Card	110		110			N/A	
Radio Modem Communications Card	110		110			N/A	
MVS (Integral or Remote)	N/A	240	N/A	480		N/A	
I/O Modules Total from Table 1-2	N/A				N/A	N/A	
Radio Power Consumption	N/A				N/A	N/A	
						TOTAL	

NOTE: 1. For the Analog Input, the Duty Cycle is the percent of time spent in the upper half of the operating range.

Table 1-2. Power Consumption of the I/O Modules

I/O Module	Power Consumption (mW)				QTY	Duty Cycle	Sub-Total (mW)
	12 Volt		24 Volt				
	Pmin	Pmax	Pmin	Pmax			
AI Loop	170	495	170	495			
AI Differential	75	75	75	75			
AI Source	110	305	130	470			
AO Source	145	585	145	585			
RTD Input: P_{min} is at –50°C (–58°F); P_{max} is at 100°C (212°F)	240	475	475	930			
DI Isolated	1	10	1	10			
DI Source	1	55	1	205			
PI Isolated	1	30	1	30			
PI Source	1	70	1	230			
SPI Isolated	1	10	1	10			
SPI Source	1	55	1	205			
Low-Level PI	1	45	1	45			
DO Isolated	1	25	1	25			
DO Source (P_{max} is at 57 mA)	30	815	30	1585			
DO Relay 12 volts	15	375	N/A	N/A			
DO Relay 24 volts	N/A	N/A	20	470			
HART Interface Module	85	685	85	1285			
I/O MODULES TOTAL							

Notes: 1. For analog I/O channels, the Duty Cycle is the percent of time spent in the upper half of the operating range.
2. The P_{max} amount includes any power drawn by a FloBoss-powered field device, such as a transmitter.

1.5.2 Determining Radio Power Consumption

In determining power requirements for radios:

1. Estimate the Duty Cycle for the radio.

The Duty Cycle is the percentage of time the radio is transmitting (TX). For example, if a radio is transmitting 1 second out of every 60 seconds, and for the remaining 59 seconds the radio is drawing receive (RX) power, the Duty Cycle is:

Duty Cycle = TX time ÷ (TX time + RX time) = 1 sec ÷ 60 sec = 0.0167

2. Calculate the total power consumed by a radio, obtain the power (P) consumption values for transmit and receive from the radio manufacturer's literature, then use the following equation to calculate the power consumption for a particular Duty Cycle:

Power = (P_{TX} x Duty Cycle) + [P_{RX} (1 – Duty Cycle)]

3. Determine the power consumption for all radios that use power from the FloBoss, and enter the total calculated value in the Sub-Total column in Table 1-1.

1.5.3 Totaling Power Requirements

To adequately meet the needs of the FloBoss system, it is important to determine the total power consumption to size the solar panel and battery backup requirements accordingly. For total power consumption, add the device values in Table 1-1.

Although Table 1-1 and Table 1-2 take into account the power supplied by the FloBoss to its connected devices, be sure to add the power consumption (in mW) of any other devices used with the FloBoss in the same power system, but not accounted for in the tables.

Convert the total value (in mW) to Watts by dividing it by 1000.

$$\text{mW} \div 1000 = \text{Watts}$$

For selecting an adequate power supply, use a safety factor (SF) of 1.25 to account for losses and other variables not factored into the power consumption calculations. To incorporate the safety factor, multiply the total power consumption (P) by 1.25.

$$P_{SF} = P \times 1.25 = \_\_\_\_\_ \text{ Watts}$$

To convert P_{SF} to current consumption in amps (I_{SF}), divide P_{SF} by the system voltage (V), either 12 volts or 24 volts.

$$I_{SF} = P_{SF} / V = \_\_\_\_\_ \text{ Amps}$$

1.6 Startup and Operation

Before starting the FloBoss, perform the following checks to ensure the FloBoss is properly installed.

- Make sure the enclosure has a good earth ground connected to the earth ground bus inside the enclosure.
- Seat and secure all I/O modules in their sockets.
- Check the field wiring for proper installation.
- Make sure the input power is fused at the power source.
- Make sure the input power has the correct polarity.
- Make sure the input power is at least 12.5 volts unless the LV Start Switch S1 is depressed during power-up.

⚠ CAUTION

It is important to check the input power polarity before turning on the power. Incorrect polarity can damage the FloBoss.

⚠ CAUTION

When installing units in a hazardous area, ensure that the components selected are labeled for use in such areas. Change components only in an area known to be non-hazardous. Performing these procedures in a hazardous area could result in personal injury or property damage.

1.6.1 Startup

Observe the previous cautions and apply power to the FloBoss 407. After the FloBoss completes start-up diagnostics of Random Access Memory (RAM) and other internal checks, the STATUS LED on the processor board turns on. This LED should turn on and stay on, to show that the FloBoss 407 completed a valid reset sequence. If the LED indicator does not come on, refer to Section 2, Troubleshooting and Repair for possible causes.

1.6.1.1 Performing an LV Start Switch Startup

The LV START switch (Switch S1 on Revision E or later) allows the FloBoss to power up under low-voltage conditions. Normally, the FloBoss will not start up below 12.5 volts. This is a cut-off feature designed to avoid draining down the power supply battery.

1. Remove power from the FloBoss.
2. Hold the LV START switch down during power-up to initiate this startup.

1.6.2 Operation

Once startup is successful, it is necessary to configure the FloBoss 407 to meet the requirements of the application. The manual that comes with the configuration software describes the procedures for configuring the FloBoss and calibrating the I/O. Once the FloBoss is configured and calibrated, it can be placed into operation.

⚠ CAUTION

Local configuration or monitoring of the FloBoss through its Local Port (LOI) must be performed only in an area known to be non-hazardous. Performance of these procedures in a hazardous area could result in personal injury or property damage.

1.6.2.1 Display and Keypad

The Display and Keypad allow you to access data and configuration parameters in the FloBoss 407 while on site. Refer to Section 5, Display and Keypad.

SECTION 2 – FUNCTIONALITY, WIRING BUILT-IN I/O, WIRING THE FLOBOSS, AND TROUBLESHOOTING

2.1 Scope

This section provides information and specifications concerning the two main components of the FloBoss 407, the processor board, the termination board, wiring built-in inputs, main power wiring, and troubleshooting. For options, refer to the remaining sections of this manual. Topics covered in this section are:

2.2 Product Description

This section describes the functionality of the FloBoss 407, as well as its processor and termination boards. The processor board has the microprocessor, memory components, the Keypad, display interfaces, and the connectors for mounting the communications board. The termination board has the power supply circuitry, the communications ports, I/O ports, and the on-board monitoring circuitry.

Most functions are determined by its firmware and are programmed by the factory into flash memory. The features and applications provided by the firmware, which must be configured by using ROCLINK configuration software, are:

- Either 1985 or 1992 American Gas Association (AGA) flow calculations for an orifice meter, plus AGA7 flow calculations for a turbine meter.
- Archival of data for up to 50 history points.
- Memory logging of 240 alarms and 240 events plus Audit Log events for the Measurement Canada version.
- Logic and sequencing control using a user-defined Function Sequence Table (FST) program.
- Proportional, Integral, and Derivative (PID) feedback closed loop control capability.
- Power cycling control for a radio (not available in Measurement Canada version).
- Spontaneous Report-by-Exception (SRBX) alarming capability (Version 1.05 and greater).
- Capability to load and run user programs, such as the Modbus Protocol Emulation Program.

2.2.1 Processor Board Description

The processor board components define the functionality of the FloBoss 407. The processor board provides the following:

- NEC V25+ microprocessor.
- On-board static RAM.
- Flash memory for program storage.
- Keypad port.
- Display port.
- Communications card port.
- Real-time clock.
- Battery backup power.
- Status indicator.
- Reset switch.

Figure 2-1 shows a view of the processor board mounted on the door of the FloBoss 407 case and the termination board mounted in the FloBoss 407 case.

The FloBoss 407 derives processing power from a National Electrical Code (NEC) V25+ microprocessor. The NEC V25+ is a 16-bit Complementary Metal Oxide Semiconductor (CMOS) microprocessor featuring dual 16-bit internal data buses and a single 8-bit external data bus. The FloBoss can address up to one megabyte of memory and features high-speed direct memory access.

The processor board has 512 kilobytes of Static Random Access Memory (SRAM) for storing interrupt vectors, Function Sequence Tables (FSTs), custom displays, alarms, events, user program data, and history data.

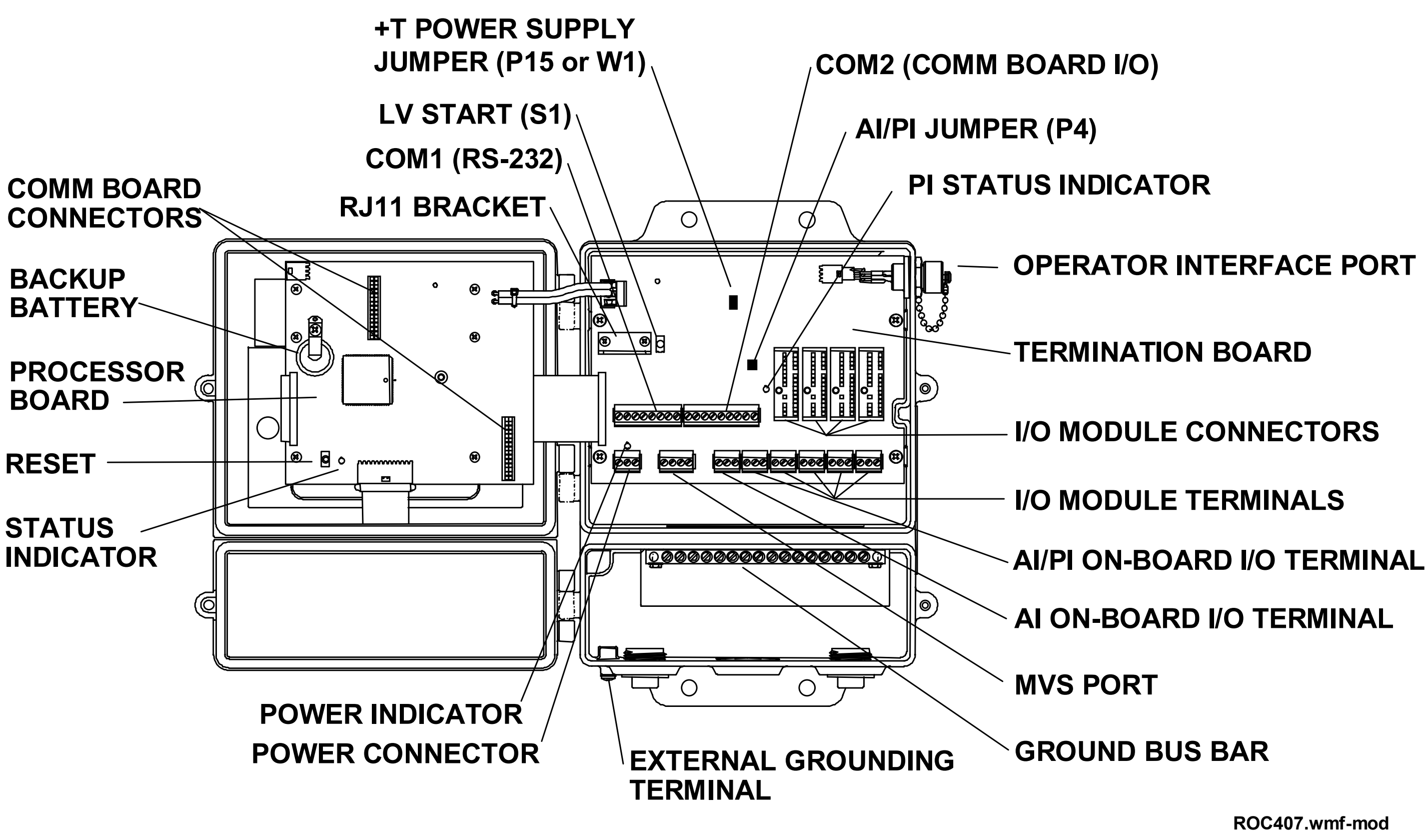


Figure 2-1. Processor and Termination Boards

The processor board has a 512 kilobytes flash memory chip for storing firmware, such as the operating system, factory code, user programs, and configuration parameters. A protected 64 kilobytes block of flash memory contains the operating system kernel (boot block). The four different flash chips determine the FloBoss 407 version as follows:

- **W68044** – Standard AGA92 Version 1.05 or greater.
- **W68073** – Standard AGA85 Version 1.05 or greater.
- **W68057** – Measurement Canada AGA92 Version 1.05 or greater.
- **W68074** – Measurement Canada AGA85 Version 1.05 or greater.

Table 2-1 shows how the FloBoss 407 memory is allocated. Each memory location range (such as 00000 to 0FFFF) represents 64 kilobytes of memory.

Table 2-1. FloBoss 407 Memory Map

Memory Location	Use
RAM	
00000 to 003FF	Interrupt Vectors
00400 to 0FFFF	Boot Block Data
10000 to 1FFFF	Event Logs, Alarm Logs, ROC Displays, FST Data, Audit Log (Measurement Canada), and other Flash Program Data
20000 to 2FFFF	Scratch Pad / Flash Program Buffer
30000 to 3FFFF	History Data
40000 to 4FFFF	History Data
50000 to 5FFFF	History Data
60000 to 6FFFF	User Program Data
70000 to 7FFFF	User Program Data
Flash Memory	
80000 to 87FFF	Configuration Save Area
88000 to 8FFFF	Factory Program
90000 to 9FFFF	Factory Program
A0000 to AFFFF	User Program
B0000 to BFFFF	User Program
C0000 to CFFFF	User Program
D0000 to DFFFF	Factory Code
E0000 to EFFFF	Factory Code
F0000 to FFFFF	Boot Block

A two-line Liquid Crystal Display (LCD) panel mounts on the display connector on the rear of the processor board. This positions the display for viewing through the main door of the enclosure.

A membrane Keypad mounts on the main door of the enclosure to navigate within the LCD. A gasketed door on the enclosure door protects the Keypad from the elements. The Keypad connects to the processor board with a ribbon cable.

The communications connectors (J1 and J2) on the processor board provide the FloBoss 407 with electrical access and mounting provisions for the optional communications cards. The communication card mounts directly on the connectors on the processor board and is held in place with a screw passing through the communications card to a standoff on the processor board. The communications cards available for the FloBoss allow the options of serial data communication, modem, radio modem, or leased-line modem communications.

A 3.6 volts lithium battery provides backup power for the RAM and the real-time clock. The backup battery mounts on the processor board with a spring clip to hold it in place. The processor board has provisions for mounting a second backup battery. This provision allows you to replace the battery without losing backup power to the FloBoss 407.

The real-time clock provides the FloBoss 407 with the time of day, date, month, year, and day of the week. The time chip automatically switches to battery power when the board loses primary input power.

An Light-Emitting Diode (LED) Status indicator on the processor board shows the system status. Refer to Section 2.5.1, LED Indicators, on page 2-20.

The Reset switch permits a special type of Cold Start from the factory default flash memory configuration rather than from the configuration saved to permanent memory (as in a Cold Start). Refer to Section 2.5.10, Performing a Reset, on page 2-25.

2.2.2 Termination Board Description

Refer to Figure 2-1. The termination board provides the following functionality to the FloBoss 407:

- 11 to 30 volts dc input power supply.
- Board temperature and voltage monitor inputs.
- Built-in field input terminals.
- Expansion I/O module terminals.
- External modem port.
- Communications card port.
- Multi-Variable Sensor (MVS) port.
- Operator interface serial port.

The FloBoss 407 operates with a 12.5 to 30 volts dc power input to the termination board. A Power indicator LED lights when an input voltage with the proper polarity and level is applied to the power terminal block if the power input fusing / protection is operational. Refer to Section 1, Performing an LV Start Switch Startup, to power up under low-voltage conditions

The FloBoss 407 power supply circuitry provides supply voltages of +5, –5, and +8.5 volts. In addition, +12 or 24 volts (+T) is provided for transmitter power using a switching regulator.

The +T voltage is used by the built-in field I/O and the plug-in I/O modules to provide power for loop-powered instruments, such as transmitters. The +T voltage depends on the setting of a jumper on the termination board located at P15 or W1. Refer to Figure 2-1 on page 2-2.

If **Jumper P15 is set to 24 volts** or if the **W1 pins are not connected** (factory default), then the +T voltage is 24 volts or greater. If the input power voltage to the FloBoss 407 exceeds 24 volts, the switching regulator shuts down and the +T voltage follows the input voltage.

If **Jumper P15 is set to 12 volts** or if the **W1 pins are connected** (supplied jumper plug), then the switching regulator no longer operates, so that the +T voltage is 12 volts, provided the input power is 12 volts. This setting should only be used when all I/O loops for this FloBoss require a 12 volts source.

For Revision D or later of the termination card, the +T voltage can be software-switched. This feature allows the +T supply to be turned on or off for field devices not requiring continuous +T power. To control the +T voltage, use the Aux Out #1 or Transmitter flag in ROCLINK configuration software.

The FloBoss 407 termination board provides a +B voltage for the plug-in field I/O modules that require it. For example, the Discrete Output (DO) Relay modules can have either a 12 volts or a 24 volts coil. The +B voltage is the same as the input voltage applied to the FloBoss 407 and the I/O module used must match the power supply input.

One over-current device and a soldered fuse on the termination board provide input power protection. The over-current device protects the fuse. Another over-current device on the termination board protects the +T outputs.

The FloBoss 407 termination board has four I/O module connectors (slots) to accommodate a variety of I/O modules. The four plug-in I/O modules allow any combination of Discrete Inputs (DIs), Discrete Outputs (DOs), Analog Inputs (AIs), Analog Outputs (AOs), or Pulse Inputs (PIs) that an application requires. I/O modules should not be used for flow inputs on a Measurement Canada FloBoss.

When installed, optional surge protection devices (Lightning Protection Modules) protect the built-in and modular input channels from voltage transients. These devices replace the field wiring terminal blocks, providing terminations for connecting the I/O wiring to the FloBoss 407. Refer to Appendix A for additional information about the Lightning Protection Modules.

The COM1 terminal block on the termination board provides wiring access to a built-in EIA-232 (RS-232) serial interface.

If the FloBoss 407 processor board has an optional communications card installed, the COM2 terminal block on the termination board provides wiring access for the communications card. Depending on the type of card, this port allows the FloBoss 407 to connect to a radio, to public, leased, or customer-owned telephone lines, to another device via serial communications. The termination board has a bracket to hold an RJ11 connector for communications cards that provide a telephone line hook-up.

The MVS port on the termination board allows the FloBoss 407 to communicate directly with a Multi-Variable Sensor (MVS). The MVS is a flow monitoring device that collects temperature and pressure data, making it available to the FloBoss 407 through this specialized serial port. This port can function as a multi-drop port for installations with as many as four MVS units connected to the FloBoss 407. Refer to Appendix B and the *ROC/FloBoss Accessories Instruction Manual* (Form A4637).

The local operator interface (LOI Local Port) connector provides direct communications between the FloBoss 407 and the serial port of an operator interface device, such as a notebook computer. The interface allows you access to the FloBoss 407 for configuration for transferring stored data.

2.2.3 Flow Measurement

One of the primary functions of the FloBoss 407 is to measure the flow of natural gas in accordance with the 1985 or 1992 American Petroleum Institute (API) and American Gas Association (AGA) standards. The FloBoss performs either 1985 or 1992 AGA3 orifice calculations, depending on which was ordered (firmware Version 1.04 and earlier contains both). In addition, all versions of FloBoss 407 firmware contain the AGA7 turbine meter flow calculation function. Certain flow calculations may be configured for either Metric or English units.

The primary inputs used for the **orifice metering** flow measurement functions are differential pressure, static pressure, and temperature. Inputs come from the Multi-Variable Sensor (MVS) with the temperature input acquired from an RTD probe, whether connected to the MVS or not.

The 1985 flow calculation is in accordance with AGA Report No. 3 1985 and AGA Report No. 8 1985 (ANSI/API 2530-85 and API Chapter 14.2), and API Chapter 21.1.

The 1992 flow calculation is in accordance with AGA Report No. 3 1992 (ANSI/API 2530-92), AGA Report No. 8 1992 2nd printing 1994 (API Chapter 14.2), and API Chapter 21.1.

The primary inputs used for the **turbine metering** flow measurement functions are meter pulse, static pressure, and temperature. These inputs typically come through I/O modules installed on the FloBoss. The flow calculation is in accordance with AGA Report No. 7.

2.2.4 Diagnostic Inputs

Three diagnostic Analog Inputs monitor input power voltage, +T voltage, and board temperature. These values can be observed with ROCLINK configuration software or with the Local Display Panel.

The diagnostic Analog Inputs are:

- +T voltage – Point Number E1.
- Power input voltage – Point Number E2.
- Board temperature – Point Number E5.

2.2.5 Built-in Inputs

The on-board (built-in) field I/O channels provide two Analog Inputs (AIs). One AI can be configured as a Pulse Input (PI). These I/O channels are suitable for use as flow inputs, including flow measurement in the Measurement Canada version of the FloBoss 407.

Two plug-in terminal blocks provide termination for the built-in I/O channels. Jumper P4 on the termination board provides the input type selection for the AI/PI channel. With P4 set to “PI,” the channel becomes a Pulse Input. The Pulse Input can be connected as either a sourced or an isolated input. An LED indicator (PI IND) shows when the field input to the Pulse Input channel is active.

2.2.6 History Points

A total of 50 (ROCLINK for Windows) or 200 (ROCLINK 800) history points may be set up and accessed in the FloBoss 407. The first six or eight are pre-configured for flow history on Meter Run #1 (required for Electronic Flow Metering or Measurement – EFM reporting). These points can be changed if required. The time stamp for periodic logging consists of the month, day, hour, and minute. The exception is for FST Second logging, in which the time stamp consists of the day, hour, minute, and second.

The FloBoss has a **Minute** Historical Log for every history point. The Minute Historical Log stores the last 60 minutes of data from the current minute. Each history point has Minute Historical Log entries, unless the history point is configured for FST-controlled logging. By using the FST Editor utility, the period in which the data is logged can be placed under program control.

The FloBoss has a total of 840 **Hourly** Historical Logs available for every history point. The Hourly Historical Log is also called the Periodic Log. Normally, the Hourly Log is recorded every hour at the top of the hour. The exception is for FST-controlled logging.

The FloBoss has a total of 35 **Daily** Historical Logs for every history point. The Daily Historical Log is recorded at the configured contract hour every day with a time stamp that is the same as the Hourly Historical Log. Each history point has daily historical log entries, unless the history point is configured for FST-controlled logging.

2.2.7 Alarm, Audit, and Event Logs

Alarm, Event, and Audit Logs are stored in non-volatile RAM in the FloBoss. Note that they are not stored to flash ROM when the Flash Memory Save Configuration or Write to EEPROM function is used in the configuration software. The logs have the capacity to store up to 240 logs in a “circular” fashion, with new entries overwriting the oldest entry when the buffer is full.

In addition to providing functionality for appending new alarms, system events, and audit events to the logs, the logs allow host packages to request the index of the most recent log entry. The logs are available internally to the system, to external host packages, to FSTs, and to User C programs.

Alarm Logs and Event Logs are not stored to the flash ROM during the Flash Memory Save Configuration or Write to EEPROM function in the configuration software.

The **Alarm Log** records instances when exceptions from field inputs and calculations occur. The Alarm Log has information fields which include time and date stamp, alarm Clear or Set indicator, and either the Tag name of the point which was alarmed with the current value or a 14 ASCII character description. The Alarm Log provides an audit history trail of past operation and changes. The Alarm Log is stored separately to prevent recurring alarms from overwriting configuration audit data.

The **Event Log** contains a record of past operator changes and system events, such as power-downs. The Event Log is stored separately from the Alarm Log to prevent recurring alarms from overwriting configuration change events.

The **Audit Log** is a specialized type of Event Log set up only for the Measurement/Industry Canada version of the FloBoss. It contains changes to any flow-related parameters made through the protocol. Once the Audit Log fills up, you must save the log to a disk file to clear the audit flag. The FloBoss then allows parameter changes and resumes recording audit events. The Audit Log has information fields that include point type, parameter number, time and date stamp, point number if applicable, the operator identification, and either the previous and current parameter values or a 14-byte ASCII description.

2.2.8 Function Sequence Tables (FSTs)

The FloBoss supports FST user programmability. The four FST programs can consist of 300 lines each of code. The FST code resides in battery backed-up static RAM.

2.2.9 PID Control

The Proportional, Integral, and Derivative (PID) Control functionality is used to provide control of a Process Variable to a user-entered Setpoint by automatically adjusting the output to a regulating device, such as a control valve. PID Control can only be implemented if I/O modules are installed to provide a control output. This output can be achieved either through an Analog Output or through a pair of Discrete Outputs for open/close control. Override Control of a secondary variable may also be set up.

2.2.10 Power Control

The Power Control function (available in standard firmware only) is used with a communications port to provide power savings when using a radio or cell phone for communications. Three cycling “zones” are provided, but zones can be disabled as desired. Either a Discrete Output module (COM1 or COM2) or the DTR signal (COM2 only) provides the switching mechanism.

The Power Control function calculates which zone should be currently active. The Power Control begins in the ON state and continues with a full On Time and then goes to the OFF state for the full Off Time.

2.2.11 Spontaneous Report By Exception (SRBX) Alarming

SRBX alarming enables a communications port to be set up to enable the FloBoss to contact the host computer when specified alarm conditions exist.

2.2.12 Fuses

The FloBoss 407 uses the overload protection devices listed in Table 2-2. The overload protection devices are not field replaceable.

Table 2-2. Overload Protection Devices

ID	Rating	Use
F1	3A	100 VA power limiting fuse.
PTR1	1.25A	Input power protection.
PTR2	0.30A	Analog Input 24 V dc power (“+T” terminal).

2.3 Installing the FloBoss 407

The FloBoss 407, with or without an Integral MVS, can be mounted either on a wall or on a 2-inch pipestand. When mounting the FloBoss 407 on a wall or panel, fasten with 5/16-inch U-bolts (8 mm) through each of the four mounting holes. Refer to Figure 2-2 for outline and mounting dimensions. If the FloBoss 407 has an Integral MVS, refer to the *ROC/FloBoss Accessories Manual* (Form A4637) for outline and mounting dimensions.

⚠ CAUTION

Take precautions to make sure the FloBoss is handled properly to prevent equipment damage, and make sure that personnel are aware of any site hazards.

- ❖ **NOTE:** To prolong hinge life, the FloBoss 407 should be mounted vertically. If it is necessary to mount the FloBoss 407 horizontally, make sure the hinges are located on top.

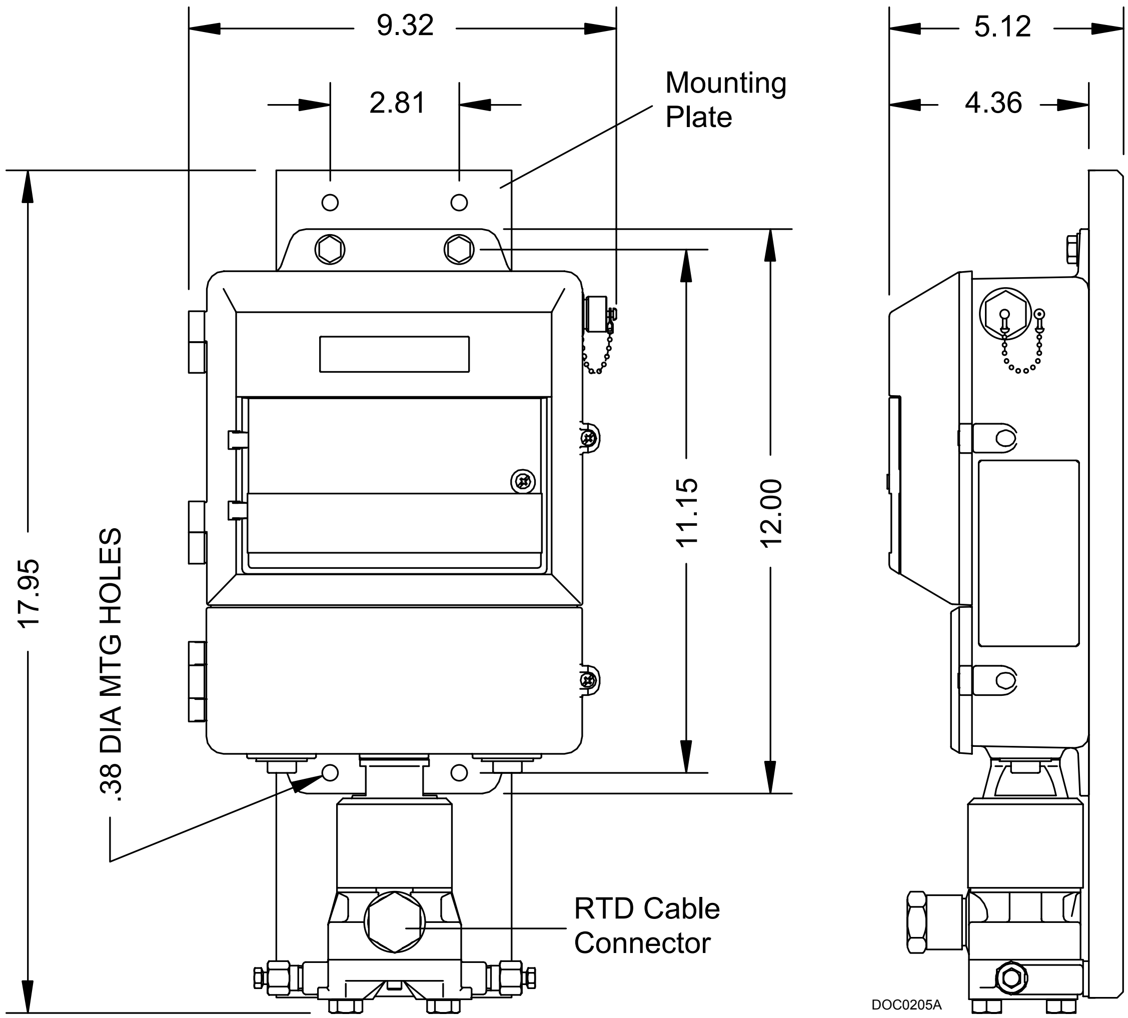


Figure 2-2. FloBoss 407 Outline and Mounting Dimensions

❖ **NOTE:** To install I/O modules in the FloBoss 407, refer to Section 3. To install a communications card in the FloBoss 407, refer to Section 4.

2.3.1 Installing the Padlock Adapter

This section details how to install a padlock adapter. Installation of other accessories for the FloBoss, such as MVS, solar panels and battery enclosures, is discussed in the *ROC/FloBoss Accessories Instruction Manual (Form A4637)*.

The optional padlock adapter (not available for Measurement Canada) installs on the captive screw that secures the electronics cover. With the shank of the padlock (purchased separately) running through the stainless steel adapter, the screw is inaccessible and the cover cannot be opened. The padlock shank can be up to 6.35 millimeters (0.25 inches) in diameter, and the body of the padlock can be up to 38.1 millimeters (1.5 inches) wide.

To install the padlock adapter:

1. Open the main (electronics) cover of the FloBoss 407.
2. Remove the old retaining washer from the screw and discard the washer.
3. Position the screw, adapter, and new washer as displayed in Figure 2-3.
4. Thread the screw through the washer and into the enclosure using a screwdriver.
5. Rotate the adapter as required using a padlock shank.
6. Install the padlock.

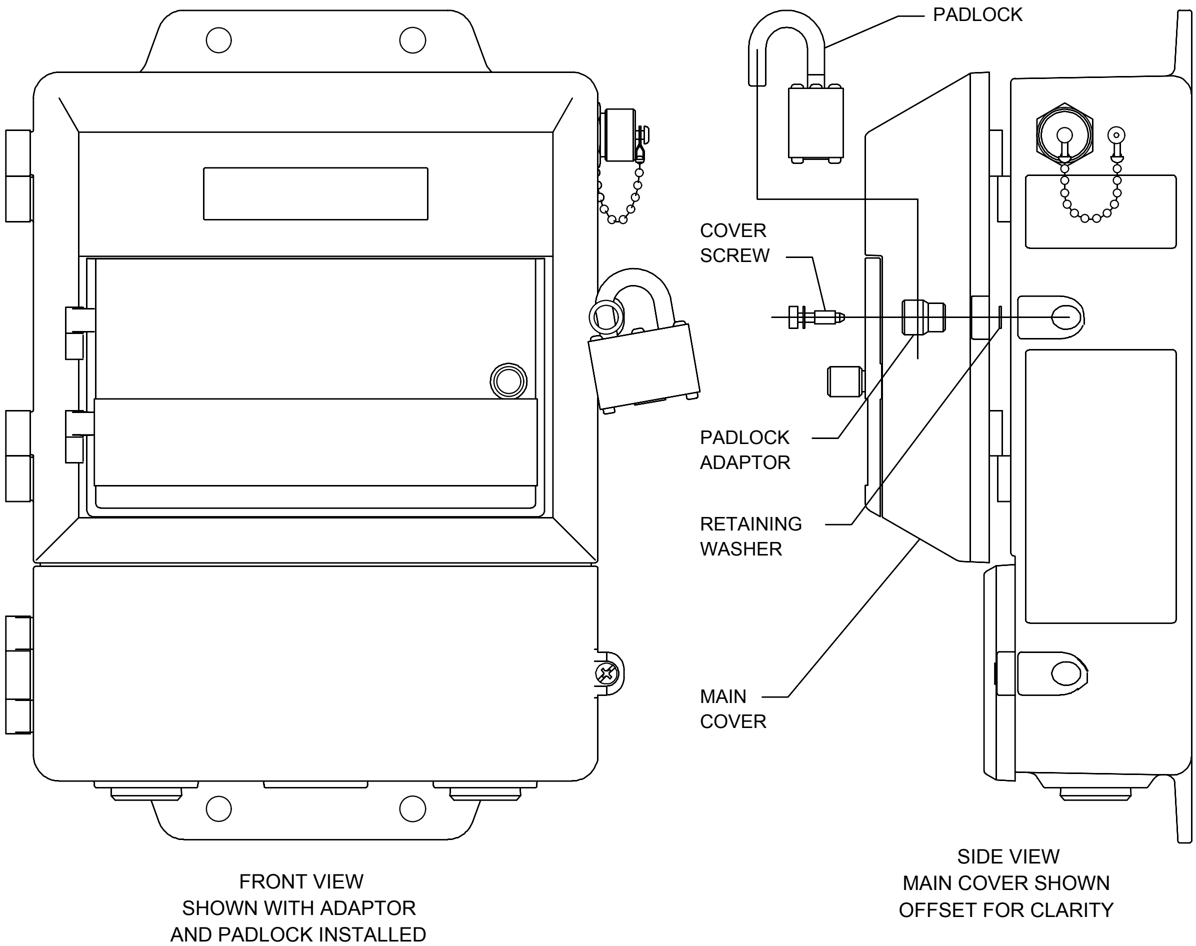


Figure 2-3. Padlock Adapter Installation

2.4 Connecting the FloBoss 407 to Wiring

The following paragraphs describe how to connect the FloBoss 407 to power, ground, I/O devices, and communications devices. Use the recommendations and procedures described in the following paragraphs to avoid damage to equipment or injury to personnel. **The FloBoss 407 terminal blocks can accommodate up to 12 American Wire Gauge (AWG) wire.**

⚠ CAUTION

Always turn off the power to the FloBoss unit before you attempt any type of wiring. Wiring of powered equipment could result in personal injury or property damage.

❖ **NOTE:** Use a standard screwdriver with a slotted (flat bladed) 1/8" width tip when wiring all terminal blocks.

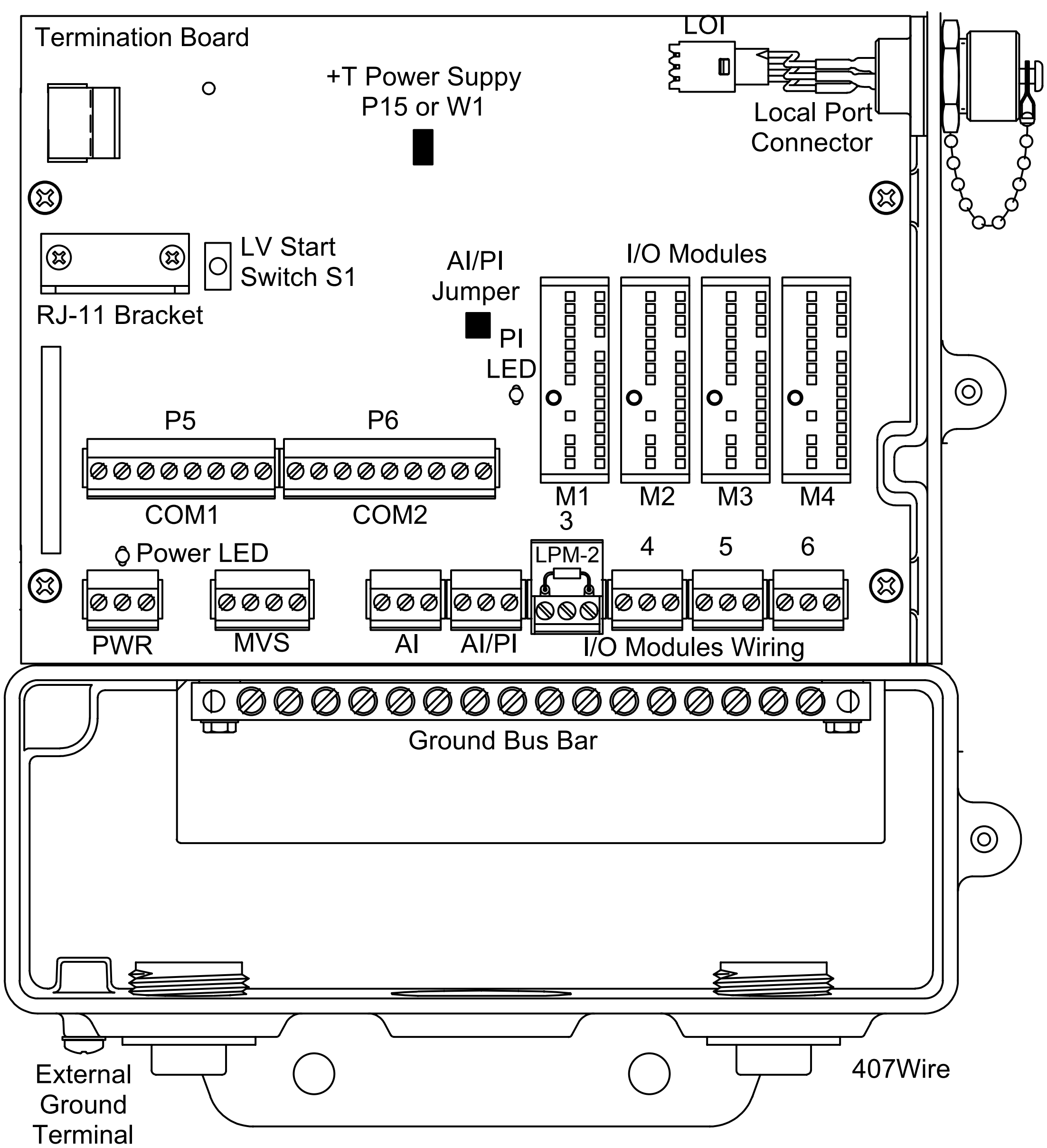


Figure 2-4. Termination Board Wiring Connections

2.4.1 Connecting Ground Wiring

Equipment Required: Small flat-blade screwdriver

The FloBoss 407 and related components must be connected to earth ground. The National Electrical Code (NEC) governs the ground wiring requirements for all line-powered devices. **It is recommended that 12 AWG wire be used for the ground wiring.**

All earth grounds must have an earth to ground rod or grid impedance of 25 ohms or less as measured with a ground system tester. The grounding conductor should have a resistance of 1 ohm or less between the FloBoss 407 case ground lug and the earth ground rod or grid.

The grounding installation method for the FloBoss depends on whether the pipeline has cathodic protection. On pipelines with cathodic protection, the FloBoss 407 must be electrically isolated from the pipeline.

Electrical isolation can be accomplished by using insulating flanges upstream and downstream on the meter run. In this case, the FloBoss 407 could be flange mounted or saddle-clamp mounted directly on the meter run and grounded with a ground rod or grid system.

Another way of providing electrical isolation would be to mount the FloBoss 407 on a pipestand and use a Remote Multi-Variable Sensor installed with non-conductive conduit. Ground the case of the FloBoss 407 to a ground rod or grid system.

On pipelines without cathodic protection, the pipeline itself may provide an adequate earth ground and the FloBoss 407 could mount directly on the meter run. Test with a ground system tester to make sure the pipeline to earth impedance is less than 25 ohms. If an adequate ground is provided by the pipeline, do not install a separate ground rod or grid system. All grounding should terminate at a single point.

If the pipeline to earth impedance is greater than 25 ohms, the FloBoss 407 installation should be electrically isolated and a ground rod or grid grounding system installed.

The FloBoss 407 has a ground bus bar located in the lower section of the enclosure. The ground bus bar is electrically bonded to the enclosure and provides space to connect ground wires from I/O devices, power input, and grounding conductors from devices used in the installation.

For line-powered devices, the grounding conductor must end at the service disconnect. The grounding conductor can be wire or metallic conduit as long as the circuit provides a low impedance ground path.

With stand-alone units, a grounding terminal on the outside of the housing allows you to ground the FloBoss 407 directly to an earth ground. Make sure the installation has only one ground point to prevent creation of a ground loop circuit. A ground loop circuit could cause erratic operation of the system.

Lightning Protection Modules (LPM) are available to provide additional lightning protection for field wiring inputs and outputs. A surge protection device installed at the service disconnect on line-powered systems offers lightning and power surge protection for the installed equipment.

2.4.2 Connecting Main Power Wiring

Equipment Required: Small flat-blade screwdriver

It is important that good wiring practice be used when sizing, routing, and connecting power wiring. All wiring must conform to state, local, and NEC codes. The terminal blocks can accommodate up to 12 AWG wire. **Use 18 AWG wire or larger for all power wiring.**

Connect power to the FloBoss 407 through the plug-in PWR terminal block on the termination board. Connect the DC power source to the "+" and "–" terminals. **Make sure the polarity is correct.** Figure 2-5 shows the location of the power indicator and the power wiring terminal block.

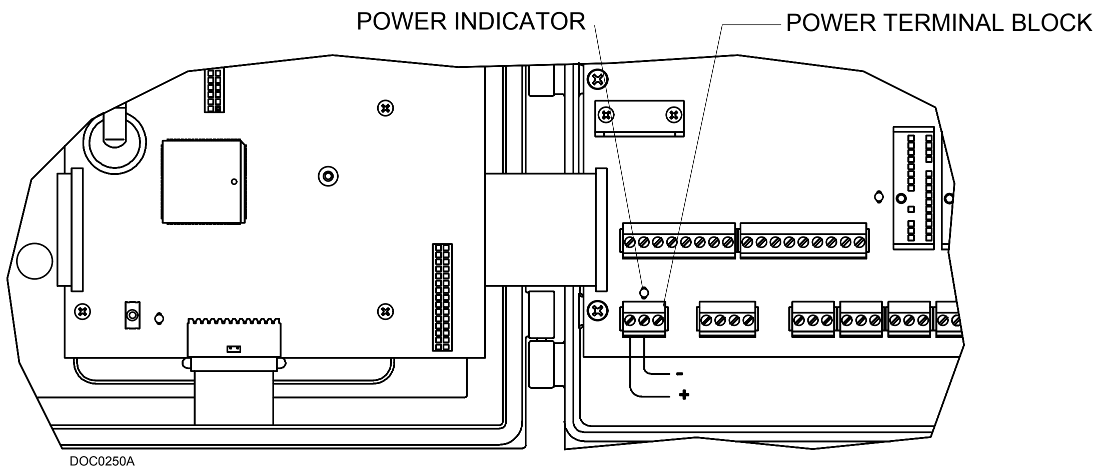


Figure 2-5. Power Wiring Connections

2.4.3 Connecting Built-in Analog Input Wiring

Equipment Required: Flat-blade (1/8-inch width) screwdriver

The Analog Input channels have three field terminals per channel. The "+T" terminal provides +24 volts dc for loop-powered devices. Each channel has a current regulator in series with the "+T" terminal to provide short-circuit protection. The maximum output of each terminal is 25 milliamps. The FloBoss 407 is shipped with a 250-ohms scaling resistor between the "+" and "–" Analog Input terminals.

The "+" terminal is the positive signal input and the "–" terminal is the negative signal input. These terminals accept a voltage signal in the 1 to 5 volts range. Because the "–" terminal is internally connected to common, the Analog Input channels function as a single-ended input only.

For use with a 4 to 20 milliamps current signal, leave the 250-ohms resistor installed between the "+" and "–" terminals. Wire the device "+" lead to the FloBoss 407 "+T" terminal and the device "–" lead to the FloBoss 407 "+" terminal. Figure 2-6 shows the wiring for a typical current signal.

For use as a voltage input, remove the 250-ohms resistor from the Analog Input terminal block. Figure 2-7 shows a typical voltage signal Analog Input.

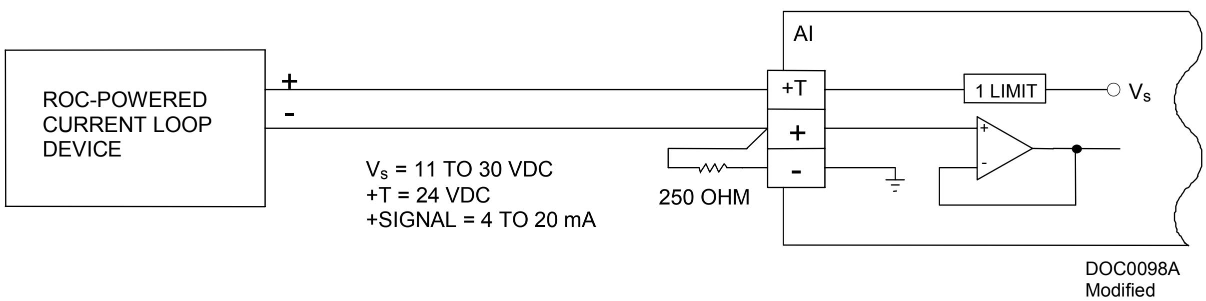


Figure 2-6. Current Signal on Built-in Analog Input

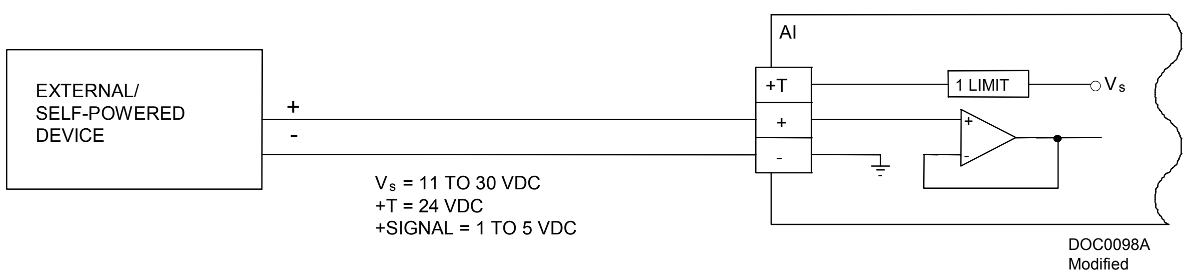


Figure 2-7. Voltage Signal on Built-in Analog Input

2.4.4 Connecting Built-in Pulse Input Wiring

Equipment Required: Flat-blade (1/8-inch width) screwdriver

Changing the P4 jumper to the "PI" position allows the built-in AI/PI input channel to be used as either an isolated or a sourced Pulse Input. This Pulse Input signal is optically isolated from the FloBoss 407 circuit board. The Pulse Input can operate at up to 10 kilohertz, with a maximum 50% Duty Cycle.

An LED indicator (PI IND) shows when the field input to the Pulse Input channel is active.

The AI/PI channel has three field terminals. Terminal "+T" is a positive source voltage, either +24 volts or a level that follows the voltage of the FloBoss 407 input power. Terminal "+" is the positive signal input. Terminal "–" is the negative signal input. **Remove the supplied 250-ohms resistor from the terminal block when using the AI/PI channel as a Pulse Input.**

To use the channel as an isolated input shown in Figure 2-8, connect the "+" and "–" field wires to terminals "+" and "–" on the FloBoss 407 Pulse Input channel. When the field device sends a voltage through terminal "+" on activation, the PI indicator LED on the termination board lights to show an active circuit and the signal triggers the optical circuitry to signal the FloBoss 407.

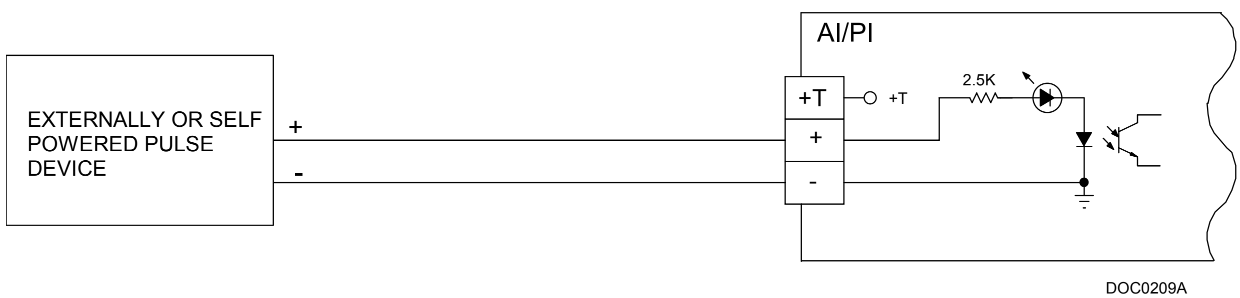


Figure 2-8. Externally-Powered Built-in Pulse Input

For use as a sourced input shown in Figure 2-9, connect the field device positive wire to terminal "+T" and the field negative lead to terminal "+". When the field device conducts, the source power flows through the LED to show an active circuit and triggers the optical circuitry to signal the FloBoss.

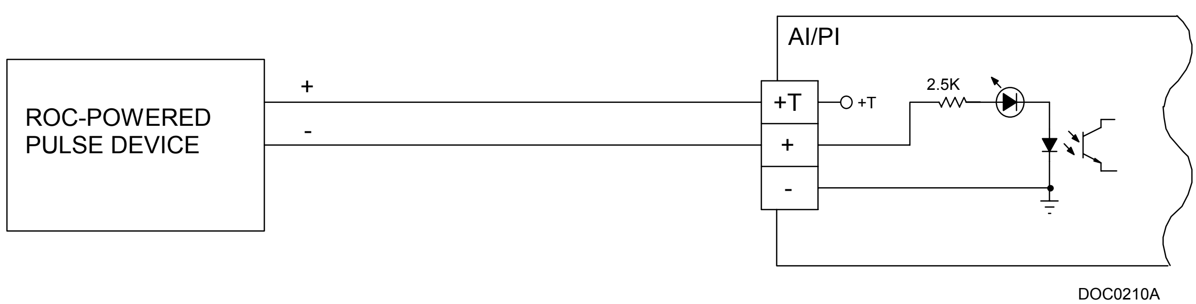


Figure 2-9. FloBoss-Powered Built-in Pulse Input

2.4.5 Connecting Communications Wiring

Equipment Required: None

The FloBoss 407 has the flexibility to communicate to external devices using several different formats and protocols. A special 3-pin connector provides a port for an operator interface device. Terminal blocks located on the termination board provide connections to the COM1 and COM2 ports. Figure 2-10 shows the COM1, COM2, and Operator Interface Local Port (LOI) locations.

The Operator Interface Local Port (LOI) provides connections for a built-in EIA-232 (RS-232) communications interface to a configuration and monitoring device. The configuration and monitoring device typically is a laptop. A null modem cable (transmit and receive wires cross-connected, plus ground) must be used between the Operator Interface connector and the PC. A prefabricated operator interface cable is available as an accessory.

The FloBoss 407 has a built-in EIA-232 (RS-232) serial interface accessible through the COM1 communications port. The port is an 8-terminal connector located on the termination board. Refer to Table 2-3 for a description of the signals available at each terminal.

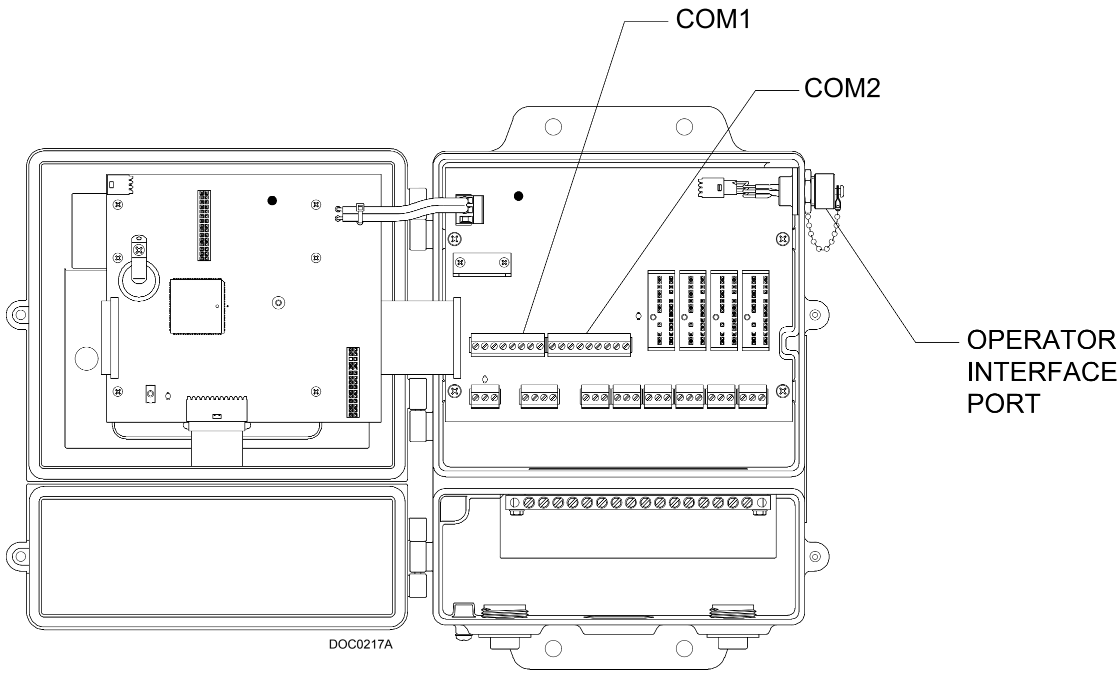


Figure 2-10. Operator Interface Local Port, COM1, and COM2 Ports

Table 2-3. COM1 Port Signals

TERMINAL	1	2	3	4	5	6	7	8
COM1 Signal	RXD	TXD	RTS	CTS	DCD	DTR*	DSR	COM
*This signal is permanently enabled (connected to +10 V dc).								

The COM2 port provides communications access to an optional plug-in communications card. Section 4 details communications cards and wiring to the COM2 connector.

2.4.6 Connecting Multi-Variable Sensor Wiring

For information on MVS wiring, refer to Appendix B and the *ROC/FloBoss Accessories Instruction Manual* (Form A4637).

2.5 Troubleshooting and Repair

Troubleshooting and repair procedures are designed to help identify and replace faulty boards and parts. Return faulty boards and parts to your local sales representative for repair or replacement. To troubleshoot I/O modules, refer to Sections 3 and for communications cards, refer to Sections 4.

The following tools are required for troubleshooting:

- ♦ IBM-compatible Personal Computer.
- ♦ ROCLINK configuration software.
- ♦ Battery-powered digital multi-meter, Fluke 8060A or equivalent.

2.5.1 LED Indicators

The FloBoss 407 has three LED indicators to verify operational functionality. Figure 2-11 shows the location of the indicators and Table 2-4 provides the indicator functions.

When lit, the POWER LED indicates that power is applied to the FloBoss 407.

The STATUS LED, on the processor board, gives a first-level indication of the operation of the FloBoss. After the power is switched on, the STATUS indicator should come on, and remain on to indicate normal operation. If the STATUS indicator does not remain on, check Table 2-4 for possible causes.

The PI LED located on the termination board shows the state of the Pulse Input channel. When the LED is on, the PI channel is active.

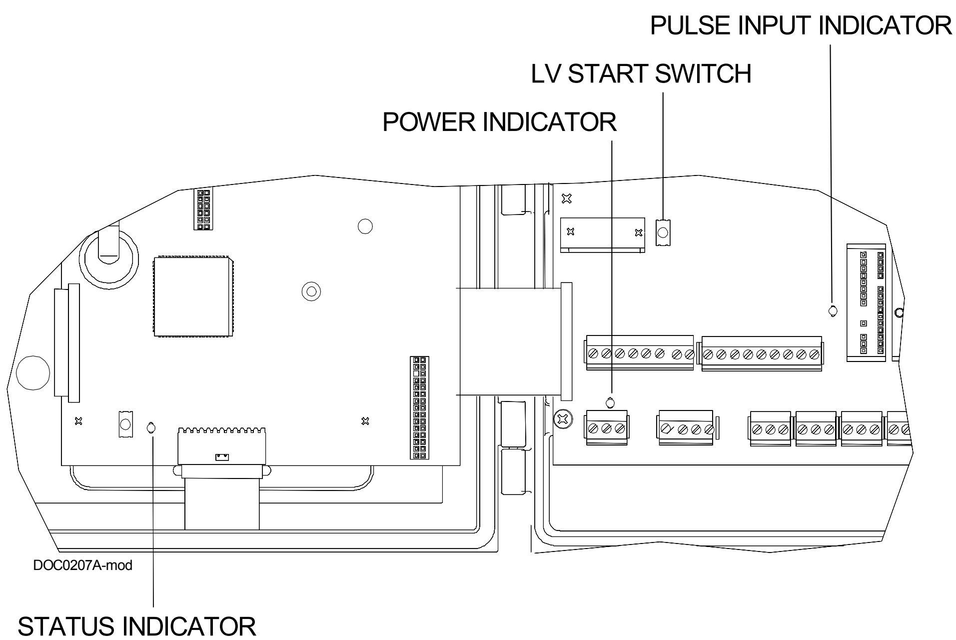


Figure 2-11. FloBoss 407 Indicator Locations

Table 2-4. Indicator Functions

Indicator	Status	Description
STATUS	ON	Successful startup and the processor is running.
	BLINKING	Processor is not running and is attempting to restart. Can result from bad battery.
	OFF	No input power, circuit protection devices overloaded, insufficient voltage available to power up, or input power polarity reversed.
POWER	ON	Power is connected. Must be minimum of 12.5 volts, unless LV START switch is used.
	OFF	Power not applied.
PI IND	ON	Input active.
	OFF	Input not active.

2.5.2 RAM Backup Procedure Before Removing Power

Use the following backup procedure when removing or adding FloBoss 407 components. Before removing power to the FloBoss for repairs, troubleshooting, or enhancements, perform the backup procedure to avoid losing the FloBoss configuration and other data held in RAM. The procedure assumes you are using ROCLINK configuration software.

User programs cannot be saved out of the FloBoss. Reload user programs from their original disk files as instructed in the *ROCLINK for Windows Configuration Software User Manual* (Form A6091) or the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

⚠ CAUTION

When installing devices in a hazardous area, make sure each device is labeled for use in such areas. Procedures involving switching power on or off, or procedures for installing or removing any wiring or components, must be performed only when the area is known to be non-hazardous. Performance of these procedures in a hazardous area could result in personal injury or property damage.

⚠ CAUTION

To avoid circuit damage when working with the FloBoss, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Save the current configuration data by selecting ROC > Flags > **Write to EEPROM** or **Flash Memory Save Configuration**. This action saves most of the FloBoss configuration (but not logs or FST programs) into the permanent memory accessed when a Cold Start is performed.
2. Save the current configuration data to disk by using the Download > **Save ROC Configuration To Disk** function. When replacing or physically upgrading a Flash memory chip, the only way to preserve configuration data is to save the data to disk and then retrieve the information after the chip is installed.
3. Save all historical database logs (Minute, Hourly, and Daily), Event Log, and Alarm Log to disk using ROC > **Collect Data "All"** function as explained in the applicable ROCLINK configuration software user manual.
4. Save the FSTs to disk using Utilities > FST Editor > FST > **Write** function in the FST Editor. Refer to the FST Editor in the applicable configuration software user manual.

2.5.3 After Installing Components

After removing power to the FloBoss and installing components as needed, perform the following steps to start your FloBoss and reconfigure your data.

❖ **NOTE:** For Measurement Canada units, maintenance and resealing of the FloBoss must be performed by authorized personnel only.

⚠ CAUTION

Ensure all input devices, output devices, and processes remain in a safe state upon restoring power. An unsafe state could result in property damage.

❖ **NOTE:** Refer to the *ROCLINK for Windows Configuration Software User Manual* (Form A6091) or the *ROCLINK 800 Configuration Software User Manual* (Form A6121) for detailed instructions concerning the following procedures.

1. Connect the **PWR** terminal block to restore power.

   ❖ **NOTE:** Due to a cut-out feature designed to avoid draining the power supply battery, the FloBoss normally requires a minimum of 12.5 volts to start up. However, this feature can be bypassed by depressing the LV START switch while applying power.

2. Using the configuration software, **check the configuration data**, including ROC Displays and FSTs. If the configuration contained in RAM was lost or corrupted, the configuration contained in flash memory will automatically be used.
3. **Load** or **modify** the **configuration** and FSTs as required.
4. **Load** and **start** any **user programs** as needed. Reload user programs from their original disk files.
5. **Verify** the **FloBoss** performs as required.
6. If you changed the configuration, save the current configuration data to permanent configuration memory by selecting ROC > Flags > **Write to EEPROM** or **Flash Memory Save Configuration**.
7. Save the FSTs to disk using Utilities > FST Editor > FST > **Write** function in the FST Editor. Refer to the FST Editor in the applicable configuration software user manual.

2.5.4 Performing a Warm Start

A Warm Start temporarily suspends all input/output (I/O) scanning. I/O processes are restarted from their last calculated values. A Warm Start clears and restarts all user-enabled flags. A Warm Start also starts all FSTs to the first instruction.

Equipment Required: Personal computer with ROCLINK configuration software

❖ **NOTE:** If your FloBoss is semi-functional, refer to Section 2.5.2, RAM Backup Procedure Before Removing Power, on page 2-21.

To perform a Warm Start using the configuration software:

1. Connect the FloBoss to the PC running ROCLINK configuration software.
2. Click ROC > Flags > Warm Start and click Apply.

To perform a Warm Start using the power option:

1. Remove power from your FloBoss.
2. Reapply power to the FloBoss.

2.5.5 Verifying the FloBoss can Communicate with the PC

Equipment Required: Personal computer with ROCLINK configuration software

To verify that the FloBoss is communicating with the PC running ROCLINK configuration software:

1. Connect the FloBoss to the PC running ROCLINK configuration software.
2. If the FloBoss is communicating with ROCLINK configuration software, COM1, COM2, COM3, or COM4 displays in the lower right corner of the screen.

2.5.6 Verifying RAM

Equipment Required: Personal computer with ROCLINK configuration software

To detect bad RAM:

1. **Connect** to ROCLINK configuration software.
2. Select ROC > Information > **Other Information** tab and verify that RAM Installed is labeled **PRESENT**.
3. The problem could be a bad backup battery or a bad solder joint of the RAM chip.

2.5.7 Verifying Battery Voltage

A battery on the processor board (B1 or B2) provides power to the real-time clock and backup power for the RAM. **If the battery fails, the clock stops running, the FloBoss stops operating, and the Status LED blinks.** The battery is a 3.6 volts lithium type and is secured with a hold-down clip. Under normal usage, this battery should last 5 to 10 years. However, if the FloBoss is powered down for long periods of time, battery life will be shortened.

To check the battery voltage:

❖ **NOTE:** For Measurement Canada units, maintenance and resealing of the FloBoss must be performed by authorized personnel only.

⚠ CAUTION

To avoid circuit damage when working with the FloBoss, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Perform the **RAM Backup Procedure** previously described in Section 2.5.2, RAM Backup Procedure Before Removing Power, on page 2-21 if possible.
2. Remove the battery from the battery socket (typically B1) by sliding the hold-down clip to one side and lifting the battery from the board. If the clip does not readily rotate, you may need to loosen the screw that secures it. Be careful not to break or bend the terminal pins.
3. Use a multi-meter to measure the voltage at the terminals of the battery that has been removed.
   - If the voltage of the battery is less than 3.6 volts, it is no longer good and must be replaced.
   - If the battery is still good, re-install it into its socket and continue with other troubleshooting procedures.

2.5.8 Replacing the Battery

To install a battery into a functioning FloBoss:

❖ **NOTE:** For Measurement Canada units, maintenance and resealing of the FloBoss must be performed by authorized personnel only.

CAUTION

To avoid circuit damage when working with the FloBoss, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

1. Locate the unused battery socket (typically B2) on the processor board. Insert the new battery in this position. Be careful not to break or bend the terminal pins.
2. Remove the old battery from the other battery socket (typically B1) by sliding the hold-down clip to one side and lifting the battery from the board. If the clip does not readily rotate, you may need to loosen the screw that secures it. Be careful not to break or bend the terminal pins.
3. Move the hold-down clip to the new battery (tighten the clip screw if you loosened it in Step 2).
4. If the old battery was too weak to power the clock (Status LED blinking), you need to reset the clock and reload the configuration. Refer to Section 2.5.3, After Installing Components, on page 2-22.

2.5.9 Performing a Cold Start

To perform a Cold Start:

1. **Connect** to ROCLINK configuration software.
2. Perform the **RAM Backup Procedure** previously described in Section 2.5.2, RAM Backup Procedure Before Removing Power, on page 2-21 if possible.
3. Select ROC > **Flags**.
4. Select the **Cold Start** checkbox.
5. Click the **Cold Start Options** button.
6. Select the appropriate **option** and click **OK**.

2.5.10 Performing a Reset

When you have tried the previous methods for convincing your FloBoss to cooperate and all other troubleshooting procedures have failed, perform a Reset before returning your FloBoss to the factory.

A Reset reloads all configuration data from Electrically Erasable Program Read-Only Memory (EEPROM), clears all history, clears the Event Log, clears the Alarm Log, and clears all ROC Displays, disables all user program tasks, and disables all user data types.

The Reset switch permits a restart from the boot block of the flash memory (Cold Start) rather than from RAM (Warm Start).

The following list shows the values that are saved to memory and restored after a Reset.

- Device Address and Group.
- Station Name.
- Number of history points in each module.
- Contract hour.
- AI Calibration.
- History point configuration.
- I/O parameters.
- All communication port settings, including power control settings.
- Radio Power Control parameters.
- AGA parameters.
- Proportional, Integral, and Derivative (PID) parameters.
- Configurable Opcode parameters.
- FST Tags and Registers.
- Softpoint parameters.
- User program enable flags – COM1, COM2, and USER/CALC.

1. Perform the **RAM Backup Procedure** previously described in Section 2.5.2, RAM Backup Procedure Before Removing Power, on page 2-21 if possible.
2. **Remove power** from the FloBoss.
3. Press the **Reset** button and hold while **returning power** to the FloBoss.
4. **Connect** your FloBoss to a computer running ROCLINK configuration software.
5. Select Utilities > **Download User Programs** or **User Program Administration**.
6. Clear all **User Programs** (**Clear All**) and click **OK** or **Update**.
7. Select ROC > **Flags**.
8. Select the **Clear EEPROM** checkbox or click **Flash Memory Clear** and click **Apply**.
9. Select the **Cold Start** checkbox.
10. Click the **Cold Start Options** button.
11. Select the **Restore Config & Clear All of the Above** (Cold Start & Clear All) radio button and click **OK**.

2.5.11 Testing the Built-in Analog Input

Equipment Required: Multimeter
1 kilohm resistor
0-5 kilohms potentiometer
PC with ROCLINK configuration software installed

If a built-in Analog Input does not function correctly, first determine if problem is with the field device or the FloBoss 407 I/O circuitry.

1. Disconnect the I/O terminal block to isolate the field device from the FloBoss I/O.
2. If the FloBoss 407 provides loop power source, measure the voltage between terminal "+T" and "–" of the AI channel under test. The loop power should be 23 volts dc minimum with jumper P15 in the 24 volts position (W1 open), or near to input power voltage with jumper P15 in the 12 volts position (W1 installed).
3. Disconnect power to the FloBoss.

4. With an ohmmeter, check between terminals "+T" and "–" of the AI channel under test. If 0 ohms, the input has shorted components.
5. Replace the termination board if the above tests indicate a fault. Refer to Section 2.5.14, Replacing the Termination Board, on page 2-28.
6. Connect a lead of a 250 ohms resistor and a 5 kilohms potentiometer to the "+" terminal of the AI channel. Connect the other resistor lead to terminal "–" and the potentiometer to terminal "+T" of the AI channel under test.
7. Connect the FloBoss 407 to a PC running the configuration software. Power up the FloBoss 407.
8. Turn the potentiometer to vary the input to simulate a transmitter. Use ROCLINK configuration software to confirm the input value changes.

A positive result on the above tests would show the FloBoss 407 input is operational. Check the field wiring and transmitters for a fault.

2.5.12 Testing the Built-in Pulse Input

Equipment Required: Multimeter
Jumper wire
PC with ROCLINK configuration software installed

Use the following tests to verify operation of the AI/PI channel when it is configured as a Pulse Input (AI/PI jumper in the PI position).

1. Isolate the field device from the FloBoss 407 by disconnecting the AI/PI terminal block.
2. If the FloBoss 407 provides power to the field device, measure the voltage between terminal "+T" and "–" of the AI/PI channel. This voltage should be 23 volts dc minimum with jumper P15 in the 24 volts position (W1 open), or near 12 volts dc to input power voltage with jumper P15 in the 12 volts position (W1 installed).
3. Connect a jumper from terminal "+T" to terminal "+" on the AI/PI connector. The LED labeled PI IND on the termination board should light.
4. Connect the FloBoss 407 to a PC running the configuration software.
5. Connect a jumper from terminal "+T" to terminal "+" on the Pulse Input connector. The PI LED on the termination board should light. Use ROCLINK configuration software to confirm that the input value changes for Point Number.

Replace the termination board if the above tests indicate failure. Refer to Section 2.5.14, Replacing the Termination Board, on page 2-28. A positive result on the above tests would show that the input is operational. Check the field wiring and transmitters for a fault.

2.5.13 Replacing the Processor Board

Equipment Required: Hex nut driver
PC with ROCLINK configuration software installed

To replace the FloBoss processor board:

❖ **NOTE:** For Measurement Canada units, maintenance and resealing of the FloBoss must be performed by authorized personnel only.

⚠ CAUTION

When installing devices in a hazardous area, make sure each device is labeled for use in such areas. Procedures involving switching power on or off, or procedures for installing or removing any wiring or components, must be performed only when the area is known to be non-hazardous. Performance of these procedures in a hazardous area could result in personal injury or property damage.

⚠ CAUTION

To avoid circuit damage when working with the FloBoss, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

⚠ CAUTION

During this procedure, all power will be removed from the FloBoss and devices powered by the FloBoss. Ensure that all connected input devices, output devices, and processes will remain in a safe state when power is removed from the FloBoss and when power is restored to the FloBoss.

1. Perform the RAM backup procedure. Refer to Section 2.5.2, RAM Backup Procedure Before Removing Power on page 2-21.
2. Disconnect the PWR input connector from the termination board.
3. Unplug the processor board power supply cord on the termination board at P1.
4. Disconnect the ribbon cable at P3 on the processor board.
5. Disconnect the Keypad ribbon connector at P4 on the processor board.
6. Remove the communications card, if present, by removing its retaining screw and unplugging the card from its mating connectors.
7. Remove the six nuts securing the processor board, and lift the board out of the case.
8. Remove the LCD from the processor board.
9. Install the LCD on the new processor board.
10. Place the new processor board in the case. Install the screws to secure the board to the case.
11. Install the Keypad ribbon connector at P4 on the processor board.
12. Install the ribbon cable at P3 on the processor board.
13. Install the communications card if required.
14. Plug the processor board power supply cord into P1 on the termination board.
15. Refer to Section 2.5.3, After Installing Components on page 2-22.

2.5.14 Replacing the Termination Board

Equipment Required: Small Philips screwdriver
PC with ROCLINK configuration software installed

To replace the termination board:

CAUTION

When installing devices in a hazardous area, make sure each device is labeled for use in such areas. Procedures involving switching power on or off, or procedures for installing or removing any wiring or components, must be performed only when the area is known to be non-hazardous. Performance of these procedures in a hazardous area could result in personal injury or property damage.

CAUTION

To avoid circuit damage when working with the FloBoss, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

CAUTION

During this procedure, all power will be removed from the FloBoss and devices powered by the FloBoss. Ensure that all connected input devices, output devices, and processes will remain in a safe state when power is removed from the FloBoss and also when power is restored to the FloBoss.

❖ **NOTE:** For a Measurement Canada FloBoss 407, resealing of the case must be performed by authorized personnel only.

1. Perform the RAM backup procedure. Refer to Section 2.5.2, RAM Backup Procedure Before Removing Power on page 2-21.
2. Disconnect the PWR input connector (terminal block) from the termination board.
3. Disconnect all connected field wiring, including MVS, built-in inputs, and I/O modules. This can be done by unplugging the terminal blocks.
4. Disconnect all communication card and RJ11 wiring if necessary.
5. Disconnect the ribbon cable at P3 on the termination board.
6. Disconnect operator interface Local Port wiring on the termination board at P2.
7. Disconnect the processor board power connector from the termination board at P1.
8. Remove the five screws securing the termination board, and lift the board out of the case.
9. Place the new termination board in the case and install the securing screws to the case.
10. Connect the ribbon cable at P3 on the processor board.
11. Connect the communication card wiring, if required.
12. Connect the field wiring.
13. Connect the operator interface Local Port wiring on the termination board at P2.
14. Connect the processor board power connector to the termination board at P1.
15. Plug the processor board power supply cord into P1 on the termination board.
16. Refer to Section 2.5.3, After Installing Components on page 2-22.

2.5.15 Replacing the Flash ROM

Equipment Required: Flash ROM extractor
PC with ROCLINK configuration software installed

⚠ CAUTION

When installing devices in a hazardous area, make sure each device is labeled for use in such areas. Procedures involving switching power on or off, or procedures for installing or removing any wiring or components, must be performed only when the area is known to be non-hazardous. Performance of these procedures in a hazardous area could result in personal injury or property damage.

⚠ CAUTION

To avoid circuit damage when working with the FloBoss, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

⚠ CAUTION

During this procedure, all power will be removed from the FloBoss and devices powered by the FloBoss. Ensure that all connected input devices, output devices, and processes will remain in a safe state when power is removed from the FloBoss and when power is restored to the FloBoss.

❖ **NOTE:** A firmware upgrade can also be performed without removing the flash chip. Refer to the Update Firmware procedure described in the *ROCLINK for Windows Configuration Software User Manual* (Form A6091) or the *ROCLINK 800 Configuration Software User Manual* (Form A6121). The Update Firmware method cannot be used for Measurement Canada. **Authorized personnel must use the Replace the Flash ROM procedure for Measurement Canada.**

To replace the FloBoss 407 flash ROM chip:

1. Perform the RAM backup procedure. Refer to Section 2.5.2, RAM Backup Procedure Before Removing Power, on page 2-21.
2. Disconnect the PWR input connector from the processor board.
3. Using a Flash ROM Extractor, remove the flash ROM chip located at U2 on the termination board.
4. Gently press the new flash ROM chip into the socket located at U2 on the termination board. The flash ROM chip should fit securely into the socket.
5. Connect the PWR input connector to the processor board.
6. Refer to Section 2.5.3, After Installing Components, on page 2-22.
7. Install the updated firmware and user programs into the flash ROM (if required).

2.5.16 Keypad and Display Replacement

To replace a damaged or faulty Keypad or Display, contact your local sales representative.

2.5.17 Integral MVS Replacement

To replace an Integral MVS, contact your local sales representative.

2.6 FloBoss 407 Specifications

The following pages provide a table of specifications for the FloBoss 407.

FloBoss 407 Specifications

PROCESSOR

NEC V25+ running at 10 MHz.

MEMORY

Program: 512 K flash ROM (electrically programmable) for firmware, configuration, etc.

Data: 512 K battery-backed SRAM.

Memory Reset: When used during power-up, Reset switch initializes communication port hardware and communications port processing for all ports.

TIME FUNCTIONS

Clock Type: 32 kHz crystal oscillator with regulated supply, battery-backed. Year/Month/Day and Hour/Minute/Second.

Clock Accuracy: 0.01%.

Watchdog Timer: Hardware monitor expires after 1.2 seconds and resets the processor. Processor restart is automatic.

DIAGNOSTICS

These values are monitored and alarmed: RAM validity/operation, analog input mid-scale voltage, power input voltage, and board temperature.

COMMUNICATIONS PORTS

Operator Interface: EIA-232 (RS-232D) format. Software configured; 300 to 19,200 bps rate selectable. Screw-cap protected connector.

COM1: EIA-232 (RS-232D) format for general use. Software configured; 300 to 9600 bps rate selectable. Eight-terminal connector provided on I/O board.

COM2: Serial or modem interface, with optional communications card. Nine-terminal connector provided on I/O board.

POWER

Input: 11 to 30 V dc. 0.8 W typical, excluding power for input sourcing, I/O modules, MVS, and communications card.

Loop/Source: Normally 23 V dc minimum provided for transmitter power at the “+T” terminals (25 mA maximum) and at the “A” terminals on the modular I/O channels.

ANALOG INPUTS (BUILT-IN)

Quantity/Type: 1 or 2 single-ended voltage-sense (current loop if scaling resistor is used).

Terminals: “+T” loop power, “+” positive input, “–” negative input (common).

Voltage: 0 to 5 V dc, software configurable. 4 to 20 mA, with a 250 ohm resistor installed across terminals “+” and “–”.

Accuracy: 0.1% over operating temperature range.

Impedance: One megohm.

Filter: Double-pole, low-pass.

Resolution: 12 bits.

Conversion Time: 30 microseconds.

PULSE INPUT (BUILT-IN)

Quantity/Type: 1 high-speed source or isolated pulse counter input when PI jumper is set.

Terminals: “+T” source power, “+” positive input, “–” negative input (common).

Voltage: 8 to 30 V dc (ON state); 0 to 4 V dc (OFF state).

Frequency: 10 kHz maximum.

Sample Period: 50 ms minimum.

MVS INTERFACE

Type: High-speed, multi-drop, serial interface with power for as many as 4 MVS units located up to 1220 m (4000 ft) from the FloBoss 407 unit.

Terminals: “A” and “B” for data; “+” and “–” for power.

Polling Period: 1 sec max.

I/O MODULES (OPTIONAL)

Four slots provided for optional I/O modules. Any type and combination of I/O modules can be used.

FRONT-PANEL USER INTERFACE

Display: 2 line by 20 character LCD. Overall size is 19 mm by 82.6 mm (0.75 by 3.25 inches).

Keypad: 15 multi-function, membrane keys. Keys allow numerical entries.

FloBoss 407 Specifications (Continued)

ENVIRONMENTAL

Operating Temperature: –40 to 75°C (–40 to 167°F), excluding display, which is –20 to 70°C (–4 to 158°F).

Storage Temperature: –50 to 85°C (–58 to 185°F).

Operating Humidity: To 95% non-condensing.

Vibration: Less than 0.1% effect on overall accuracy when tested to SAMA PMC 31.1, Section 5.3, Condition 3.

EMC Emissions: Meets FCC Part 15 Class A and EN 50022 Level A in accordance with EN50081-2 (1993).

DIMENSIONS

Overall, FloBoss 407 only: 305 mm H by 236 mm W by 112 mm D (12.0 in. H by 9.3 in. W by 4.4 in. D).

Overall, with Integral MVS: 457 mm H by 236 mm W by 130 mm D (18.0 in. H by 9.3 in. W by 5.1 in. D).

Wall Mounting: 71 mm W by 308 mm H (2.8 in. W by 12.1 in. H) between mounting hole centers. Mounting hole diameter is 9.4 mm (0.37 in.).

Pipestand Mounting: Mounts on 2-inch pipe with U-bolt mounting kit (included).

ENCLOSURE

Die-cast low-copper aluminum alloy with three ¾-14 inch NPT holes in bottom. Single-piece gasketed doors. Coated with ANSI 61 gray polyurethane paint. Meets CSA Type 4X rating.

WEIGHT

FloBoss 407: 3.2 kg (7 lb.).

With Integral MVS: 7.7 kg (17 lb.).

APPROVALS

Standard Version: Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D, T4, C US.

Measurement Canada Version: Approved by Measurement (Industry) Canada for gas custody transfer, in addition to approval by CSA for hazardous locations (see Standard Version). Note that I/O Modules must not be used to supply flow inputs to the FloBoss in a Measurement Canada installation.

SECTION 3 – INPUT/OUTPUT MODULES

3.1 Scope

This section describes the Input/Output (I/O) Modules used with the FloBoss 407 Flow Manager and includes the following information:

3.2 Product Descriptions

The I/O modules plug into the FloBoss I/O module sockets and accommodate a wide range of process inputs and outputs.

❖ **NOTE:** FloBoss units used in Measurement/Industry Canada installations must not employ I/O modules for flow measurement.

The following modules are available:

- Analog Input (AI) Loop
- Analog Input (AI) Differential
- Analog Input (AI) Source
- Analog Output (AO) Source
- Discrete Input (DI) Source
- Discrete Input (DI) Isolated
- Discrete Output (DO) Source
- Discrete Output (DO) Isolated
- Discrete Output (DO) Relay
- Pulse Input (PI) Source
- Pulse Input (PI) Isolated
- Slow Pulse Input (SPI) Source
- Slow Pulse Input (SPI) Isolated
- Low-Level Pulse Input (LLPI)
- Resistance Temperature Detector (RTD) Input
- Highway Addressable Remote Transducer (HART®) Interface

Below each I/O module socket is a plug-in terminal block for field wiring connections. The plug-in terminal blocks permit removal and replacement of the modules without the need to disconnect field wiring. I/O wiring terminal blocks accept up to 12-gauge American Wire Gauge (AWG) solid or stranded copper wire. Figure 3-1 shows a typical I/O module.

❖ **NOTE:** Use a standard screwdriver with a slotted (flat bladed) 1/8" width tip when wiring all terminal blocks.

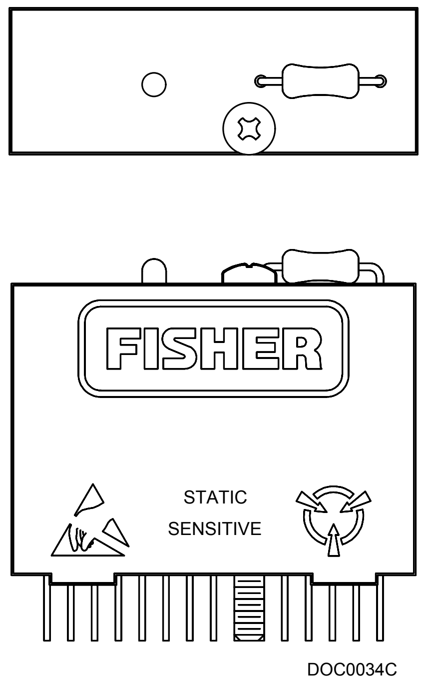


Figure 3-1. Typical I/O Module

3.2.1 Analog Input Loop and Differential Modules

The Analog Input Loop (AI Loop) and Analog Input Differential (AI Differential) modules are used for monitoring current loop and voltage output devices. Each AI module uses a scaling resistor for scaling loop current to achieve the proper input voltage.

The AI Loop module provides a source voltage for powering current loop devices and can be used as a single-ended voltage output. The AI Differential module monitors loop current or voltage input from externally-powered devices and provides electrical isolation from the FloBoss power supplies.

3.2.2 Analog Input Source Module

The Analog Input Source (AI Source) module monitors current loop or voltage output devices. The Analog Input Source module provides a regulated 10-volts source for powering a device, usually a low power transmitter, and uses a scaling resistor for converting loop current to input voltage.

3.2.3 Analog Output Source Module

The Analog Output Source (AO Source) module provides both a current and a voltage output for powering analog devices. These outputs are isolated from each other and can be used simultaneously. A scaling resistor provides a way to set the minimum loop resistance of the current loop to 0 ohms (installed) or 220 ohms (removed).

3.2.4 Discrete Input Source and Isolated Modules

The Discrete Input Source (DI Source) and Discrete Input Isolated (DI Isolated) modules monitor the status of relays, solid-state switches, or other two-state devices. Each module can accommodate one DI.

Both types of modules provide an LED that lights when the input is active. Both types of modules use a scaling resistor for scaling the input range. Functions supported by both modules are: Latched Discrete Input, Standard Discrete Input, and Time-Duration Input (TDI).

The DI Source module provides a source voltage for dry relay contacts or for an open-collector solid-state switch. The DI Isolated module accepts an external voltage from a powered two-state device and provides electrical isolation from the FloBoss power supplies.

3.2.5 Discrete Output Source and Isolated Modules

The Discrete Output Source (DO Source) and Discrete Output Isolated (DO Isolated) modules provide two-state outputs to energize relays and power small electrical loads. Each module provides one DO.

Both types of modules provide an LED that lights when the input is active. Both modules are fused for protection against excessive current. Functions supported by both modules are: Latched Discrete Output, Toggle Discrete Output, Timed Duration Output (TDO), and TDO Toggle.

The DO Source module supplies switched current-limited power to small loads. The DO Isolated module acts as a solid-state normally-open switch for activating externally powered devices. The solid-state switch is optically isolated from the power supplies in the FloBoss.

3.2.6 Discrete Output Relay Module

The Discrete Output Relay (DO Relay) module provides two sets of “dry” relay contacts to switch voltages of up to 250 volts ac. One set of contacts is normally open and the other set is normally closed. Two types of relay modules are available, one with a 12 volts dc energizing coil and the other with a 24 volts dc energizing coil.

The DO Relay provides an LED that lights when the input is active and functions supported by the module include: Latched Discrete Output, Toggle Discrete Output, Timed Duration Output (TDO), and TDO Toggle.

3.2.7 Pulse Input Source and Isolated Modules

The Pulse Input Source (PI Source) and Pulse Input Isolated (PI Isolated) modules count pulses from pulse-generating devices. Each module can accommodate one Pulse Input.

Both types of modules provide an LED that lights when the input is active. Both types of modules use a scaling resistor for scaling the input range. Input pulses are counted by a 16-bit counter capable of storing up to 6.5 seconds of pulse counts for a 10 kilohertz input signal. Functions supported by both modules include slow-counter input, slow rate input, fast counter input, and fast rate input.

❖ **NOTE:** At the maximum input frequency of 10 kilohertz, the input pulses must not exceed 6.5 seconds of pulse counts. The PI module limit is 20 seconds of pulse counts at 3 kilohertz maximum input frequency.

The PI Source module provides a source voltage for dry relay contacts or for an open-collector solid-state switch. The PI Isolated module accepts an external voltage from a powered device and provides electrical isolation from the FloBoss power supplies.

3.2.8 Slow Pulse Input Source and Isolated Modules

The Slow Pulse Input Source (SPI Source) and Slow Pulse Input Isolated (SPI Isolated) modules count the changes in the status of relays, solid-state switches, or other two-state devices. Each module can accommodate one Pulse Input.

The modules provide an LED that lights when the input is active. Both types of modules use a scaling resistor for scaling the input range. Functions supported are controlled by the FloBoss firmware. For example: Raw Pulse Accumulation, Running Total (Entered Rollover) in engineering units (EUs), Rate (Max Rollover) in EUs, Today's Total (Max Rollover) in EUs, or Rate Alarm.

The SPI Source module provides a source voltage for dry relay contacts or for an open-collector solid-state switch. The SPI Isolated module accepts an external voltage from a powered two-state device and provides electrical isolation from the FloBoss power supplies.

3.2.9 Low-Level Pulse Input Module

The Low-Level Pulse Input module counts pulses from pulse-generating devices having a voltage range of 30 millivolts to 3 volts peak-to-peak. The module can accommodate one Pulse Input.

Input pulses are counted by a 16-bit counter that is capable of storing up to 22 seconds of pulse counts for a 3 kilohertz input signal. The module provides electrical isolation between the input pulses and the FloBoss power supplies.

3.2.10 RTD Input Module

The Resistance Temperature Detector (RTD) module monitors the temperature signal from an RTD source. The module can accommodate one input from a two-, three-, or four-wire RTD source.

The active element of an RTD probe is a precision, temperature-dependent resistor, made from a platinum alloy. It has a predictable positive temperature coefficient, meaning its resistance increases with temperature. The RTD input module works by supplying a small current to the RTD probe and measuring the voltage drop across it. Based on the voltage curve of the RTD, the signal is converted to temperature by the FloBoss firmware.

3.2.11 HART Interface Module

The HART Interface Module provides communications between a FloBoss and other devices using the Highway Addressable Remote Transducer (HART) protocol. The module has its own microprocessor and mounts in the I/O module sockets.

The HART Interface Module communicates digitally to HART devices through the I/O termination blocks associated with the module position. Each HART module contains two separate channels. Each channel polls all HART devices connected to it before the other channel is polled. Each channel can be configured to operate in either the point-to-point mode or the multi-drop mode. In the point-to-point mode, each module channel supports one HART device.

In the multi-drop mode, each channel can support up to five HART devices for a total of ten devices for each module. By using the multi-drop mode with multiple HART modules, up to 32 HART devices (limited by ROCLINK configuration software) can be supported by a single FloBoss.

3.3 Initial Installation and Setup

Each I/O module installs in the FloBoss in the same manner. Any I/O module can be installed into any I/O module socket. To install a module on a FloBoss that is not in service, perform the following steps. For an in-service FloBoss, refer to Section 3.5, Troubleshooting and Repair, on page 3-23.

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

⚠ CAUTION

When preparing a unit for installation into a hazardous area, change components in an area known to be non-hazardous.

❖ **NOTE:** FloBoss units used in Measurement/Industry Canada installations must not employ I/O modules for flow measurement.

1. Install the I/O module by aligning the pins with the desired I/O module socket and pressing gently, but straight down.
2. Tighten the module retaining screw.
3. Make sure a field wiring terminal block is installed in the socket adjacent to where the I/O module was installed. If a Lightning Protection Module is to be installed for this I/O channel, refer to Appendix A.

3.3.1 Calibrating an I/O Module

After an I/O module is installed, configure, and calibrate the associated I/O channel using ROCLINK configuration software.

3.4 Connecting the I/O Modules to Wiring

Each I/O module electrically connects to field wiring by a separate plug-in terminal block. In addition, the FloBoss enclosures provide a ground bus bar for terminating the sheath on shielded wiring. The following paragraphs provide information on wiring field devices to each type of I/O module. I/O wiring terminal blocks accept up to 12-gauge AWG solid or stranded copper wire.

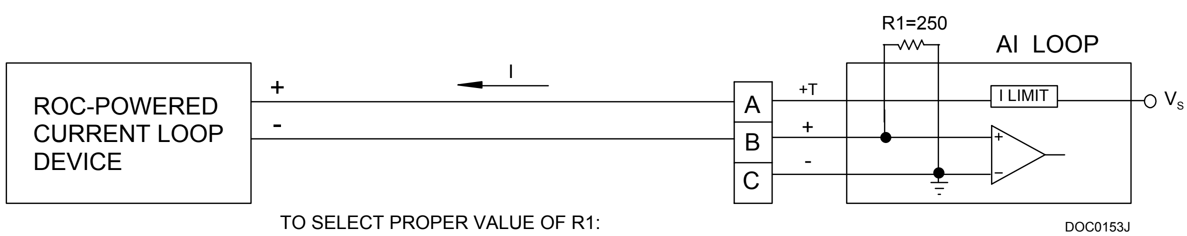
CAUTION

The sheath surrounding shielded wiring should never be connected to a signal ground terminal or to the common terminal of an I/O module. Doing so makes the I/O module susceptible to static discharge, which can permanently damage the module. Connect the shielded wiring sheath to a suitable earth ground only.

3.4.1 Analog Input Loop Module

The Analog Input Loop module monitors either loop current or output voltage from field devices. The module provides source power at terminal A for the loop. The AI Loop module operates by measuring the voltage at terminals B and C. For current loop monitoring, scaling resistor R1 generates a voltage across terminals B and C that is proportional to the loop current (I). A 250-ohms scaling resistor (R1) is supplied by the factory (0.1%, 1/8 watts) to accommodate either 0 to 20 milliamps or 4 to 20 milliamps current loop transmitters. This translates to a maximum operating input voltage of 5 volts dc, which is the upper limit of the module.

When using a transmitter with a maximum current requirement different from 20 milliamps, R1 should be scaled to achieve full-scale deflection at 5 volts dc. The formula for determining a new value of R1 is given in Figure 3-2, where "I Maximum" is the upper end of the operating current range, such as 0.025 amps for a 0 to 25 milliamps device.



TO SELECT PROPER VALUE OF R1:

V_S = SOURCE VOLTAGE FROM MODULE = 11 TO 30 VDC, 25 mA MAX

$$R1 = \frac{\text{5 VOLTS}}{\text{I MAXIMUM}}$$

Figure 3-2. AI Loop Module Field Wiring for Current Loop Devices

Figure 3-3 shows a typical voltage signal input. Terminal B is the "+" signal input and terminal C is the "–" signal input. These terminals accept a voltage signal in the 0 to 5 volts range. Since terminal C connects to a signal ground (non-isolated logic ground), the Analog Input must be a single-ended. **Ensure that no scaling resistor (R1) is installed when the module is used to sense a voltage signal**.

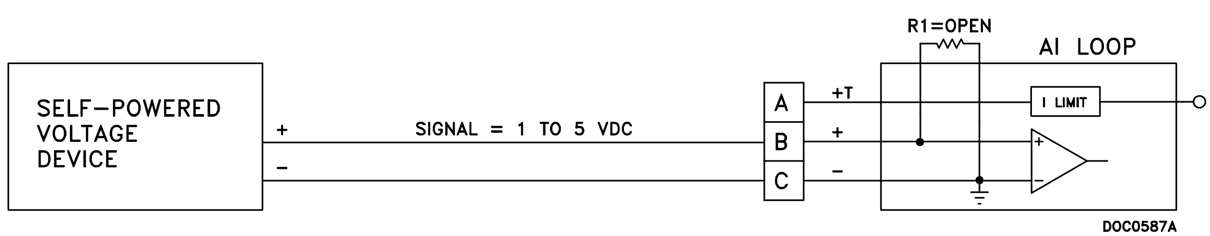


Figure 3-3. AI Loop Module Field Wiring for Voltage Devices

3.4.2 Analog Input Differential Module

A schematic representation of the field wiring connections to the input circuit of the Analog Input Differential module is shown in Figure 3-4, Figure 3-5, and Figure 3-6.

The Analog Input Differential module measures either output voltage (V_o) or loop current (I) from externally-powered devices only. The module operates by measuring the voltage between field wiring terminals B and C. The module input is semi-isolated from the FloBoss power supply and signal commons.

When connecting voltage devices, the 5-volts input voltage limit of the module must not be exceeded. If the output of the field device is in the range of 0 to 5 volts dc, **do not use a scaling resistor**; ensure that the supplied 250-ohms scaling resistor is removed. Refer to Figure 3-4 for connecting field devices with outputs of 5 volts dc or less.

The voltage cannot be negative. The A to D converter divides the 0 to 5 volts signal into 4095 counts and the last 95 counts (being 4001 to 4095) represent overvoltage. If you use a 0 to 1 volt input to the converter, the resolution is reduced, as there are only 800 counts with which to work.

For field devices with output voltages that exceed 5 volts dc, two scaling resistors, R1 and R2, are required (not supplied). Figure 3-5 shows how to connect field devices with outputs exceeding 5 volts dc and where to install scaling resistors (at least 1%, 1/8 watts). The equation for determining values of scaling resistors R1 and R2 is given in Figure 3-5. For example, if V_O = 10 volts, and R1 = 250 ohms, then R2 = 250 ohms. Note that R1 must be less than 4.5 kilohms.

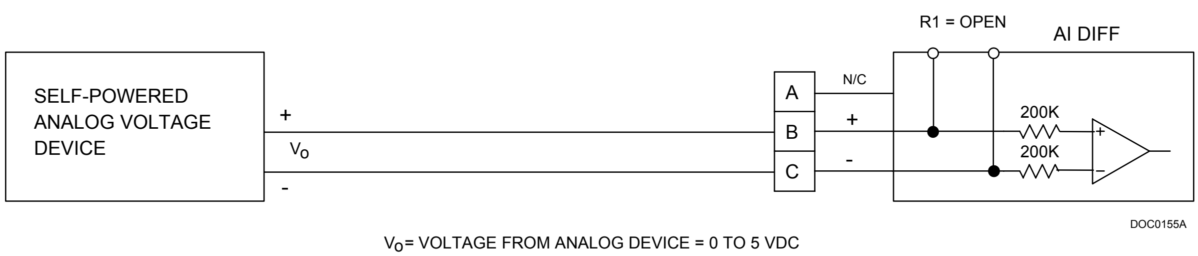


Figure 3-4. AI Differential Module Field Wiring for Low Voltage Devices

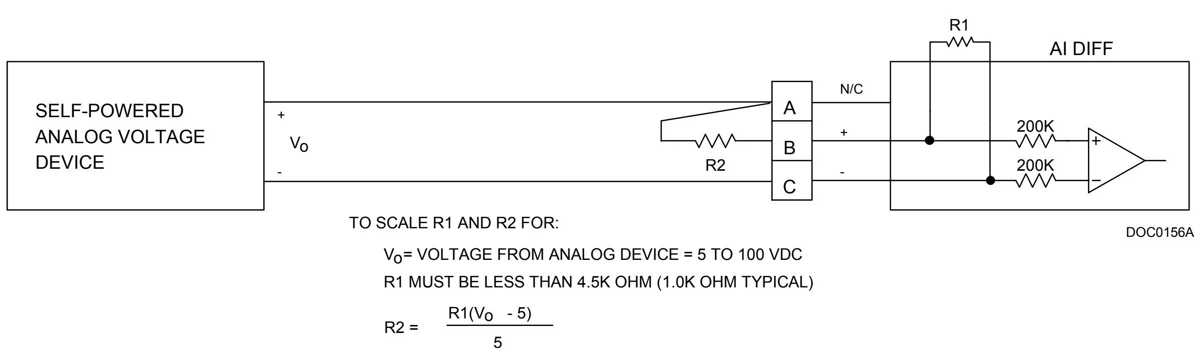


Figure 3-5. AI Differential Module Field Wiring for Higher Voltage Devices

For current loop devices, scaling resistor R1 generates a voltage across terminals B and C that is proportional to the loop current. When connecting current loop devices, the value of R1 must be selected such that the 5-volts input limit of the module is not exceeded under maximum operating current conditions. For 0 to 20 milliamps or 4 to 20 milliamps devices, the value of R1 would be 250 ohms. In this case, you can use the 250-ohms (0.1%, 1/8 watt) scaling resistor supplied by the factory. The formula for determining the value of R1 is given in Figure 3-6, where "I Maximum" is the upper end of the operating current range, such as 0.025 amps for a 0 to 25 milliamps device.

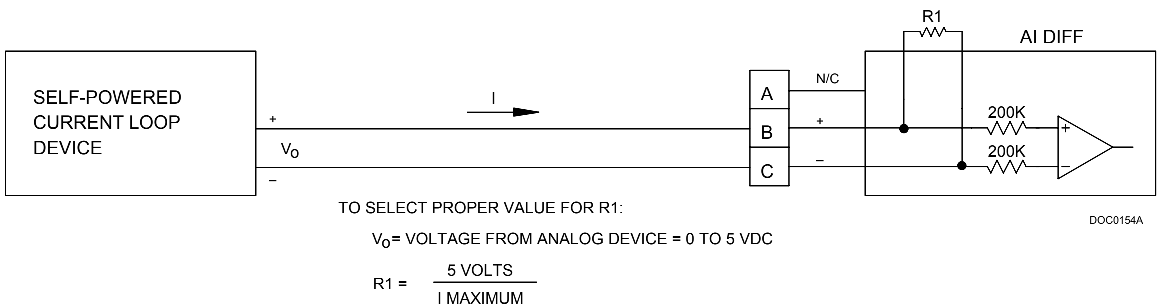


Figure 3-6. AI Differential Module Field Wiring for Current Loop Devices

3.4.3 Analog Input Source Module

A schematic representation of the field wiring connections to the input circuit of the Analog Input Source module displays in Figure 3-7 and Figure 3-8. The AI Source module normally monitors the voltage output of low-voltage transmitters, but it can be used for monitoring loop current. The module provides source power at terminal A for the loop. The Analog Input Source module operates by measuring the voltage across terminals B and C. The module accepts a maximum input voltage of 5 volts dc, which is the upper operating limit of the module.

Figure 3-7 shows a typical voltage signal input. Terminal B is the positive (+) signal input and terminal C is the negative (–) signal input. These terminals accept a voltage signal in the 0 to 5 volts range. Since terminal C connects to common, the Analog Input can only be a single-ended input. **Make sure no scaling resistor is installed when wiring the module for a voltage signal.**

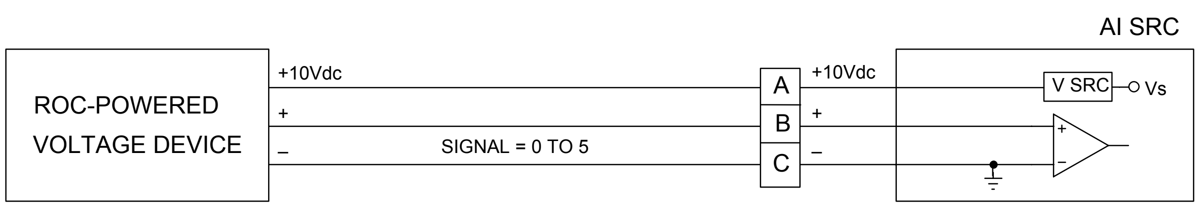


Figure 3-7. AI Source Module Field Wiring for Voltage Devices

The AI Source module can be used for monitoring loop current as shown in Figure 3-8. For current loop monitoring, scaling resistor R1 generates a voltage across terminals B and C that is proportional to the loop current (I).

For example, a 250-ohms scaling resistor would accommodate either 0 to 20 milliamps, or 4 to 20 milliamps current loop transmitters (the transmitter must be able to operate on 10 volts dc or be powered from another source). This translates to a maximum operating input voltage of 5 volts dc, which is the upper limit of the module. When using a transmitter with a maximum operating current requirement different from 20 milliamps, R1 should be sized to achieve full-scale deflection at 5 volts. The formula for determining a new value of R1 displays in Figure 3-8.

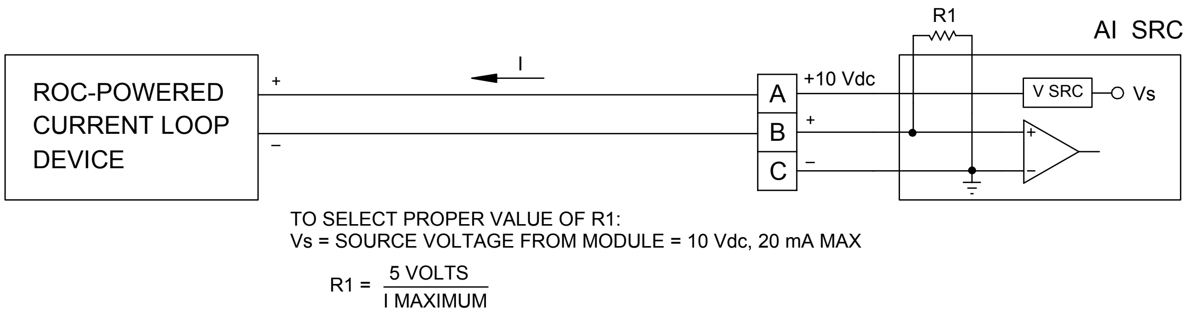


Figure 3-8. AI Source Module Field Wiring for Current Loop Devices

3.4.4 Analog Output Source Module

A schematic representation of the field wiring connections to the output circuit of the Analog Output Source module displays in Figure 3-9 and Figure 3-10. The AO Source module can provide either loop current or output voltage to non-powered field devices. The Analog Output Source module provides a 0 to 5.5 volts output at terminal A, and a 0 to 30 milliamps current source output at terminal B. Terminal C is referenced to the FloBoss common.

Resistor R1 (0-ohm resistor supplied) helps keep the loop resistance within the operating range of the module. **Remove the 0-ohm resistor when the loop resistance between terminals B and C is less than 100 ohms**.

Terminals A and B are both active at the same time. Figure 3-9 shows wiring for a FloBoss-powered current loop device, and Figure 3-10 shows wiring for an output voltage to non-powered field devices.

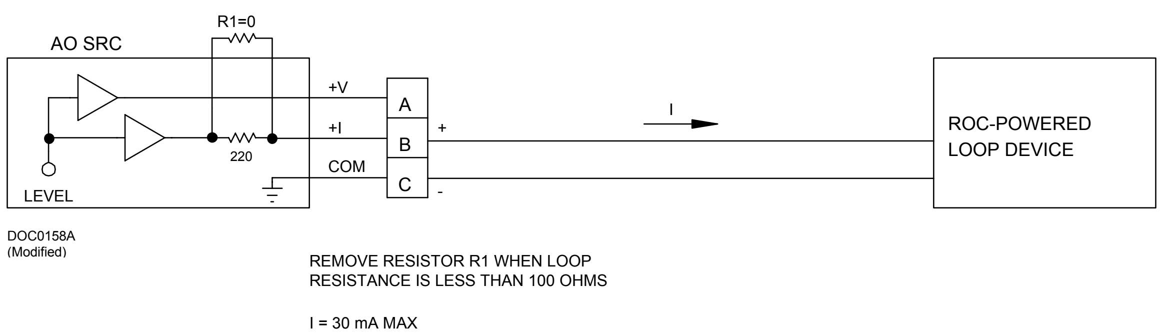


Figure 3-9. Analog Output Source Module Field Wiring for Current Loop Devices

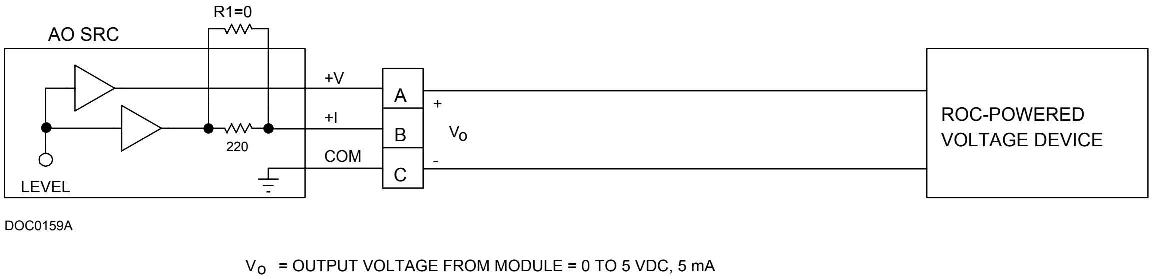


Figure 3-10. Analog Output Source Module Field Wiring for Voltage Devices

3.4.5 Discrete Input Source Module

A schematic representation of the field wiring connections to the input circuit of the Discrete Input Source module displays in Figure 3-11.

CAUTION

The Discrete Input Source module is designed to operate only with non-powered discrete devices, such as "dry" relay contacts or isolated solid-state switches. Use of the module with powered devices may cause improper operation or damage.

The Discrete Input Source module operates by providing a voltage across terminals B and C that is derived from internal voltage source V_s. When a field device, such as a set of relay contacts, is connected across terminals B and C, the closing of the contacts completes a circuit, which causes a flow of current between V_s and ground at terminal C. This current flow is sensed by the DI module, which signals the FloBoss electronics that the relay contacts have closed. When the contacts open, current flow is interrupted and the DI module signals the FloBoss electronics that the relay contacts have opened.

A 10-ohms scaling resistor (R1) is supplied by the factory and accommodates a source voltage (V_s) of 11 to 30 volts dc. The source voltage is the input voltage to the FloBoss. However, it is desirable to optimize the value of R1 to reduce the current drain from the source or reduce the heat generated in the module due to high source voltage. The formula for determining the value of R1 is given in Figure 3-11. For optimum efficiency, R1 should be scaled for a loop current (I) of 3 milliamps.

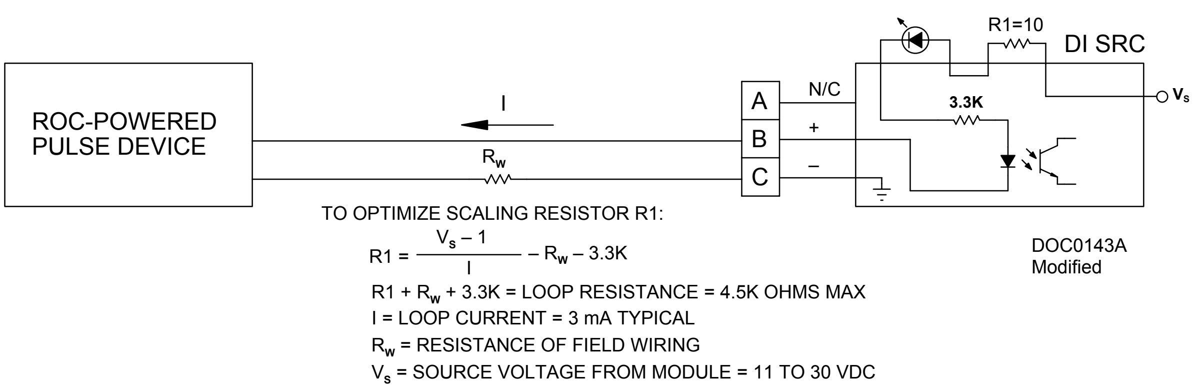


Figure 3-11. Discrete Input Source Module Field Wiring

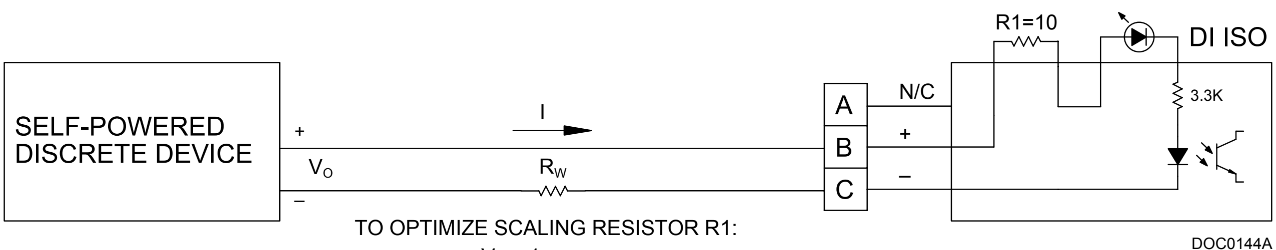
3.4.6 Discrete Input Isolated Module

A schematic representation of the field wiring connections to the input circuit of the Discrete Input Isolated module displays in Figure 3-12.

❖ **NOTE:** The Discrete Input Isolated module is designed to operate only with discrete devices having their own power source, such as "wet" relay contacts or two-state devices providing an output voltage. The module is inoperative with non-powered devices.

The Discrete Input Isolated module operates when a field device provides a voltage across terminals B and C of the module. The voltage sets up a flow of current sensed by the module that, in turn, signals the FloBoss electronics that the field device is active. When the field device no longer provides a voltage, current stops flowing and the DI module signals the FloBoss electronics that the device is inactive.

A 10-ohms scaling resistor (R1) is supplied by the factory and accommodates an external voltage (V_o) of 11 to 30 volts dc. However, it is desirable to optimize the value of R1 to reduce the current drain from the source or reduce the heat generated in the module due to high source voltage. The formula for determining the optimum value of R1 displays in Figure 3-12. For best efficiency, R1 should be scaled for a loop current (I) of 3 milliamps.



TO OPTIMIZE SCALING RESISTOR R1:

$$R1 = \frac{V_O - 1}{I} - R_W - 3.3K$$

$R1 + R_W + 3.3K$ = LOOP RESISTANCE = 4.5K OHMS MAX

I = LOOP CURRENT = 3 mA TYPICAL

R_W = RESISTANCE OF FIELD WIRING

V_O = VOLTAGE FROM DISCRETE DEVICE = 11 TO 30 VDC

Figure 3-12. Discrete Input Isolated Module Field Wiring

3.4.7 Discrete Output Source Module

A schematic representation of the field wiring connections to the output circuit of the Discrete Output Source module displays in Figure 3-13.

CAUTION

The Discrete Output Source module is designed to operate only with non-powered discrete devices, such as relay coils or solid-state switch inputs. Using the module with powered devices may cause improper operation or damage to occur.

The Discrete Output Source module provides a switched voltage across terminals B and C that is derived from internal voltage source V_s. A field device, such as a relay coil, is energized when the FloBoss electronics provides a voltage at terminals B and C. When V_s is switched off by the FloBoss electronics, the field device is no longer energized.

CAUTION

When using the Discrete Output Source module to drive an inductive load, such as a relay coil, a suppression diode should be placed across the input terminals to the load. This protects the module from the reverse Electro-Motive Force (EMF) spike generated when the inductive load is switched off.

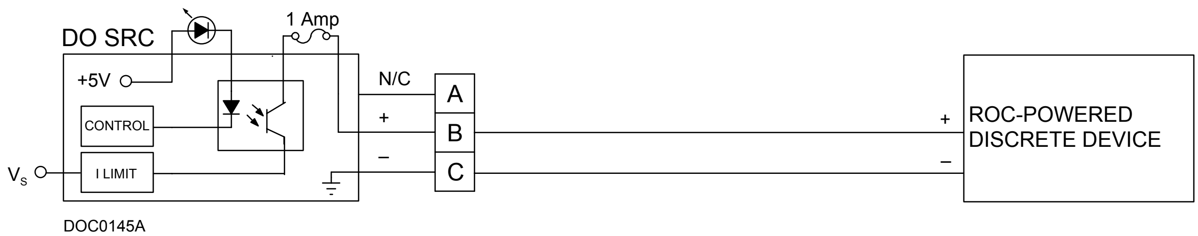


Figure 3-13. Discrete Output Source Module Field Wiring

3.4.8 Discrete Output Isolated Module

A schematic representation of the field wiring connections to the output circuit of the Discrete Output Isolated module is shown in Figure 3-14.

❖ **NOTE:** The Discrete Output Isolated module is designed to operate only with discrete devices having their own power source. The module is inoperative with non-powered devices.

The Discrete Output Isolated module operates by providing a low or high-output resistance to a field device. When the field device provides a voltage across terminals A and B of the module, current either flows or is switched off by the DO Isolated module. The switching is controlled by the FloBoss electronics.

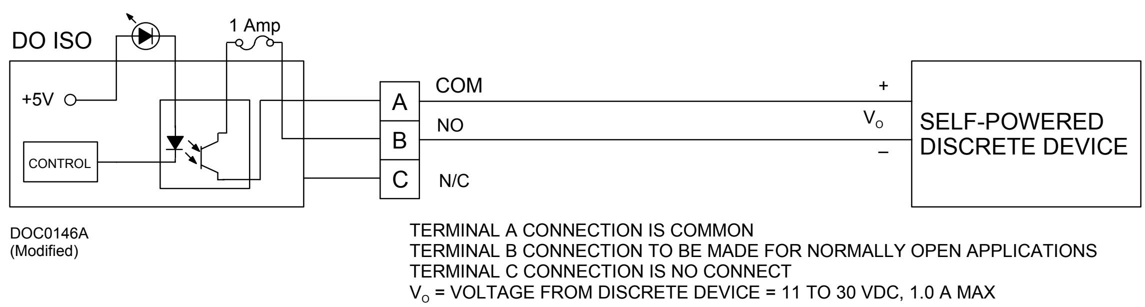


Figure 3-14. Discrete Output Isolated Module Field Wiring

3.4.9 Discrete Output Relay Module

A schematic representation of the field wiring connections to the output circuit of the Discrete Output Relay module displays in Figure 3-15.

❖ **NOTE:** The Discrete Output Relay module is designed to operate only with discrete devices having their own power source. The module will be inoperative with non-powered devices.

The Discrete Output Relay module operates by providing both normally-closed and normally-open contacts to a field device. Normally-closed contacts use terminals B and C, and normally-open contacts use terminals A and B. ROCLINK configuration software controls the status of the contacts (open or closed).

There are two versions of the DO Relay module. The 12 volts version (12 volts energizing coil) must be used when the FloBoss input voltage is a nominal 12 volts dc, and the 24 volts version (24 volts energizing coil) must be used when the FloBoss input voltage is a nominal 24 volts dc.

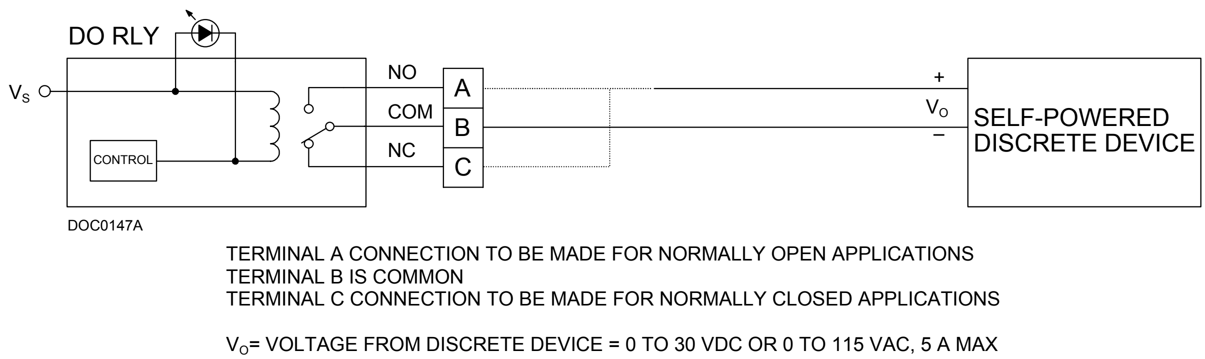


Figure 3-15. Discrete Output Relay Module Field Wiring

3.4.10 Pulse Input Source Module

A schematic representation of the field wiring connections to the input circuit of the Pulse Input Source module is shown in Figure 3-16.

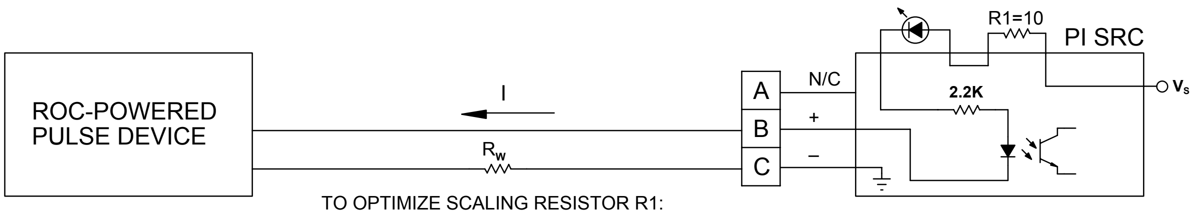
CAUTION

The Pulse Input Source module is designed to operate only with non-powered discrete devices, such as “dry” relay contacts or isolated solid-state switches. Use of the module with powered devices may cause improper operation or damage to occur.

The Pulse Input Source module provides a voltage across terminals B and C that is derived from internal voltage source V_s. When a field device, such as a set of relay contacts, is connected across terminals B and C, the opening and closing of the contacts causes current to either flow or not flow between V_s and ground at terminal C.

This interrupted, or pulsed current flow is counted and accumulated by the PI Source module, which provides the accumulated count to the FloBoss electronics upon request.

A 10-ohms scaling resistor (R1) is supplied by the factory and accommodates a source voltage (V_s) of 11 to 30 volts dc and a pulse source with a 50% Duty Cycle. The source voltage is the input voltage to the FloBoss. However, it is desirable to optimize the value of R1 to reduce the current drain from the source or reduce the heat generated in the module due to high source voltage. The formula for determining the value of R1 is given in Figure 3-16. For optimum efficiency, R1 should be scaled for a loop current (I) of 5 milliamps.



TO OPTIMIZE SCALING RESISTOR R1:

$$R1 = \frac{V_s - 1}{I} - R_w - 2.2K$$

$R1 + R_w + 2.2K$ = LOOP RESISTANCE = 3.4K OHMS MAX

I = LOOP CURRENT = 5 mA TYPICAL

R_w = RESISTANCE OF FIELD WIRING

V_s = SOURCE VOLTAGE FROM MODULE = 11 TO 30 VDC

Figure 3-16. Pulse Input Source Module Field Wiring

3.4.11 Pulse Input Isolated Module

A schematic representation of the field wiring connections to the input circuit of the Pulse Input Isolated module is shown in Figure 3-17.

❖ **NOTE:** The Pulse Input Isolated module is designed to operate only with devices having their own power source, such as "wet" relay contacts or two-state devices providing an output voltage. The module is inoperative with non-powered devices.

The Pulse Input Isolated module operates when a field device provides a voltage across terminals B and C of the module. The voltage sets up a flow of current sensed by the module. When the field device no longer provides a voltage, current stops flowing.

This interrupted, or pulsed current flow is counted and accumulated by the PI module, which provides the accumulated count to the FloBoss electronics upon request.

A 10-ohms scaling resistor (R1) is supplied by the factory, which accommodates a field device with pulse amplitude (V_o) of 11 to 30 volts dc and a Duty Cycle of 50%. However, it is desirable to optimize the value of R1 to reduce the current drain from the source or reduce the heat generated in the module due to amplitudes greater than 30 volts dc. The formula for determining the value of R1 displays in Figure 3-17. For optimum efficiency, R1 should be scaled for a loop current (I) of 5 milliamps.

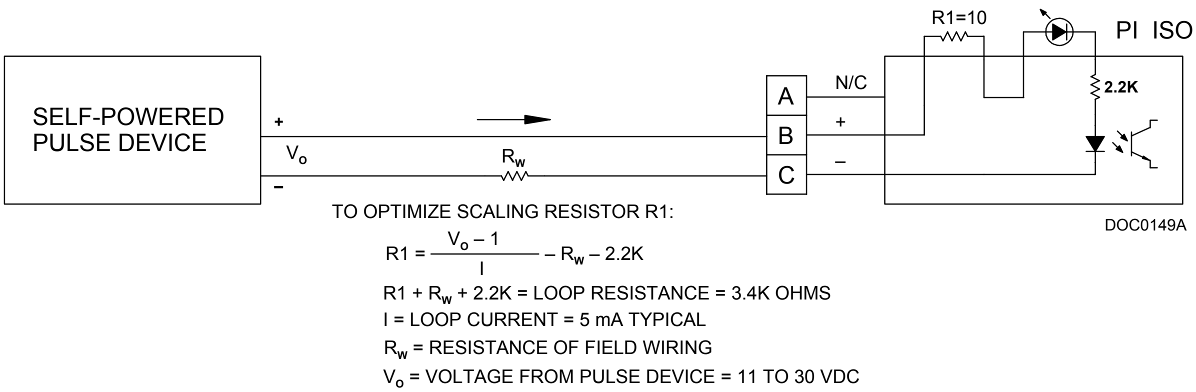


Figure 3-17. Pulse Input Isolated Module Field Wiring

3.4.12 Slow Pulse Input Source Module

A schematic representation of the field wiring connections to the input circuit of the Slow Pulse Input Source (SPI) module is shown in Figure 3-18.

CAUTION

The Slow Pulse Input source module is designed to operate only with non-powered devices, such as "dry" relay contacts or isolated solid-state switches. Use of the module with powered devices may cause improper operation or damage to occur.

The Slow Pulse Input Source module operates by providing a voltage across terminals B and C that is derived from internal voltage source V_s. When a field device, such as a set of relay contacts, is connected across terminals B and C, the closing of the contacts completes a circuit, which causes a flow of current between V_s and ground at terminal C.

This current flow is sensed by the SPI module, which signals the FloBoss electronics that the relay contacts have closed. When the contacts open, current flow is interrupted and the SPI module signals the FloBoss electronics that the relay contacts have opened. The FloBoss counts the number of times the contacts switch from open to closed, and stores the count. The FloBoss checks for the input transition every 50 milliseconds.

A 10-ohms scaling resistor (R1) is supplied and accommodates a source voltage (V_s) of 11 to 30 volts dc. The source voltage is either the input voltage to the FloBoss. However, it is desirable to optimize the value of R1 to reduce the current drain from the source or reduce the heat generated in the module due to high source voltage. The formula for determining the value of R1 is given in Figure 3-18. For optimum efficiency, R1 should be scaled for a loop current (I) of 3 milliamps.

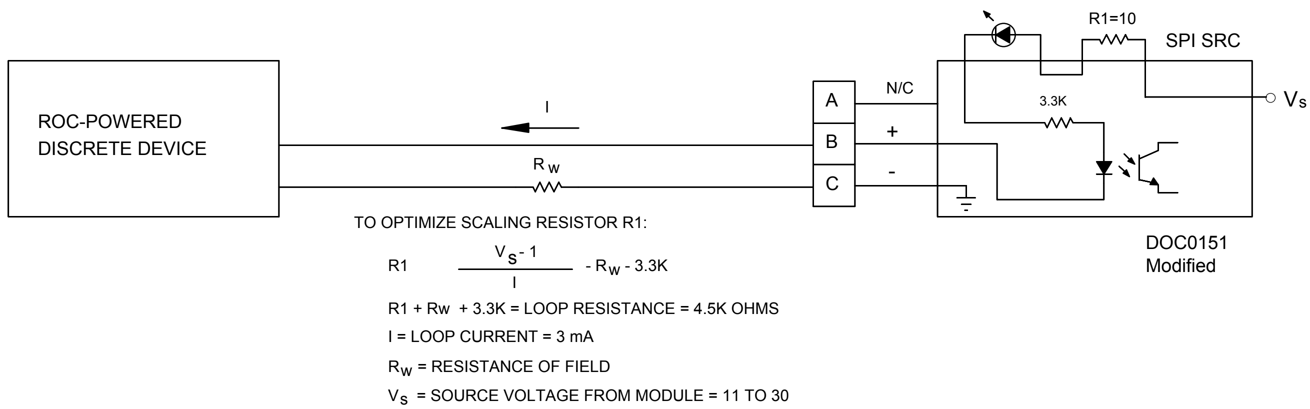


Figure 3-18. Slow Pulse Input Source Module Field Wiring

3.4.13 Slow Pulse Input Isolated Module

A schematic representation of the field wiring connections to the input circuit of the Slow Pulse Input Isolated module is shown in Figure 3-19.

❖ **NOTE:** The Slow Pulse Input isolated module is designed to operate only with devices having their own power source, such as "wet" relay contacts or two-state devices providing an output voltage. The module is inoperative with non-powered devices.

The Slow Pulse Input Isolated module operates when a field device provides a voltage across terminals B and C of the module. The voltage sets up a flow of current sensed by the module, which signals the FloBoss electronics that the field device is active. When the field device no longer provides a voltage, current stops flowing and the SPI module signals the FloBoss electronics that the device is inactive. The FloBoss counts the number of times the current starts flowing, and stores the count. The FloBoss checks for the input transition every 50 milliseconds.

A 10-ohms scaling resistor (R1) is supplied by the factory, which accommodates an external voltage (V_o) of 11 to 30 volts dc. However, it is desirable to optimize the value of R1 to reduce the current drain from the source or reduce the heat generated in the module due to high source voltage. The formula for determining the value of R1 displays in Figure 3-19. For optimum efficiency, R1 should be scaled for a loop current (I) of 3 milliamps.

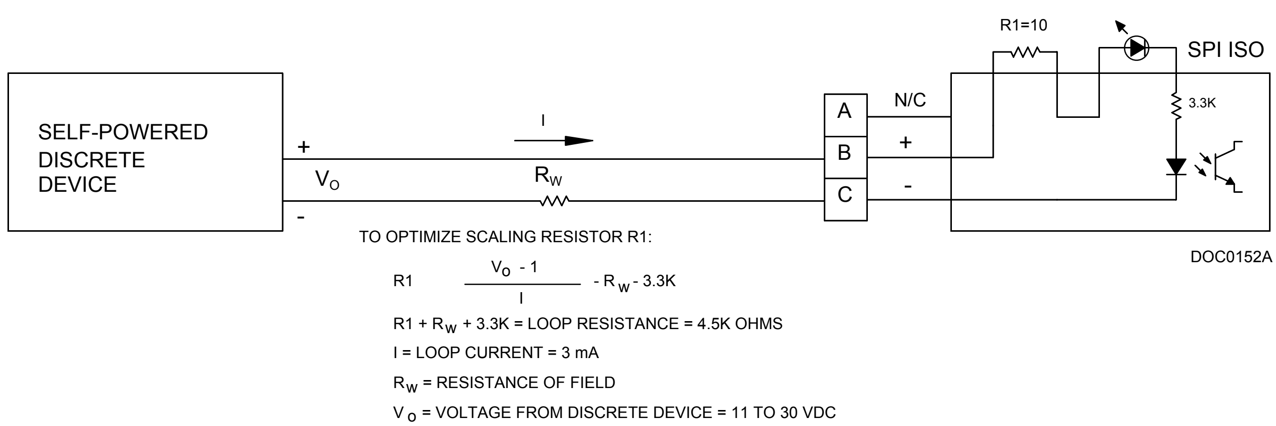


Figure 3-19. Slow Pulse Input Isolated Module Field Wiring

3.4.14 Low-Level Pulse Input Module

A schematic representation of the field wiring connections to the input circuit of the Low-Level Pulse Input module is shown in Figure 3-20. The field wiring connects through a separate terminal block that plugs in next to the module allowing replacement of the module without disconnecting field wiring.

❖ **NOTE:** The Low-Level Pulse Input module is designed to operate only with pulse-generating devices having their own power source. The module does not work with non-powered devices.

The Low-Level Pulse Input module operates when a field device provides a pulsed voltage between 30 millivolts and 3 volts peak-to-peak across terminals B and C of the module. The pulsed voltage is counted and accumulated by the module, which provides the accumulated count to the FloBoss electronics on request.

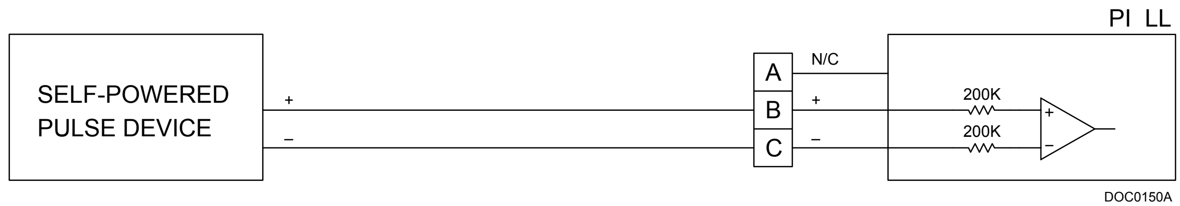


Figure 3-20. Low-Level Pulse Input Module Field Wiring Schematic

3.4.15 RTD Input Module

The RTD input module monitors the temperature signal from a Resistance Temperature Detector (RTD) sensor or probe. The RTD module is isolated, reducing the possibility of lightning damage. A Lightning Protection Module (LPM) will not protect the RTD, but it helps protect the rack in which the module is installed.

The RTD module must to be calibrated while disconnected from the RTD probe; therefore, it may be more convenient to perform calibration before connecting the field wiring. However, if the field wiring between the FloBoss and the RTD probe is long enough to add a significant resistance, then calibration should be performed in a manner that takes this into account.

For a three- or four-wire RTD with the wires used to connect up each leg are of the same length and size, the error generated will be zero or at least no different for any given length. This is because the RTD input uses the resistance of the wire loop(s) not passing through the RTD to correct for the wire resistance of the loop with the RTD.

3.4.15.1 Calibrating the RTD Module

The following instructions describe how to calibrate an RTD input channel for use with an RTD probe having an alpha value of either 0.00385 or 0.00392 ohms/degree C. This procedure requires a resistance decade box with 0.01-ohm steps and an accuracy of ±1%. You also need a personal computer running ROCLINK configuration software.

❖ **NOTE:** In ROCLINK configuration software, use the Calibrate button associated with the Analog Input configuration.

❖ **NOTE:** The RTD module input can be calibrated before installing it in the field when short wire runs will be used, but if the RTD module is used as a temperature input to a flow calculation, then the RTD should be calibrated at the same time as the pressure inputs.

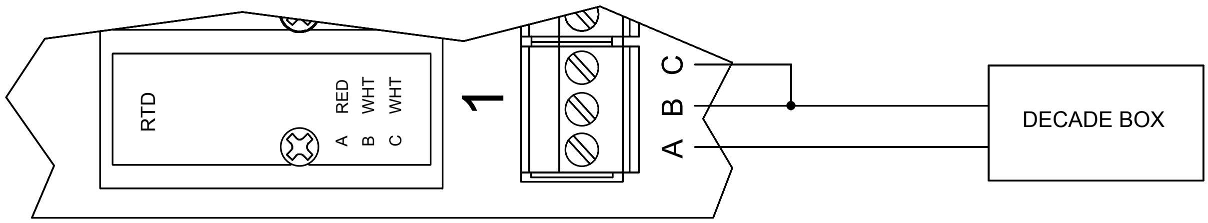


Figure 3-21. Calibration Setup

Table 3-1. Calibration Resistance Values

ALPHA	–50ºC (58ºF)	100ºC (212ºF)
0.00385	80.31 Ohms	138.50 Ohms
0.00392	79.96 Ohms	139.16 Ohms
NOTE: Resistance values for RTD probes with other alpha values can be found in the temperature-to-resistance conversion table for that probe.		

1. Connect the decade box as shown in Figure 3-21.
2. Set the decade box to the –50°C (–58°F) resistance value corresponding to the RTD alpha value in Table 3-1.
3. Enter the value displayed for “Raw A/D Input” as the value for “Adjusted A/D 0%” using the Analog Inputs configuration screen for the RTD input. Refer to ROCLINK > Configure > I/O > AI Points Advanced tab.
4. Set the decade box to the 100°C (212°F) resistance value given in Table 3-1.
5. Enter the value displayed for “Raw A/D Input” as the value for “Adjusted A/D 100%” using the Analog Inputs Advanced configuration screen for the RTD input.
6. Enter –50°C (–58°F) for “Low Reading EU” using the Analog Inputs configuration screen. Refer to ROCLINK > Configure > I/O > AI Points General tab.
7. Enter 100°C (212°F) for the “High Reading EU” using the Analog Inputs configuration screen.
8. Click Apply to save the changes.

3.4.15.2 Connecting RTD Module Field Wiring

The RTD sensor connects to the RTD module with ordinary copper wire. To avoid a loss in accuracy, sensor wires should be equal in length, of the same material, and the same gauge. To avoid possible damage to the RTD module from induced voltages, sensor wires should be kept as short as possible. This is typically 3.35 meters (100 feet) or less. A schematic representation of the field wiring connections to the input circuit of the RTD input module displays in Figure 3-22, Figure 3-23, Figure 3-24, and Figure 3-25.

Two-wire RTDs are connected to module terminals A and B. Terminal B must be connected to terminal C, as shown in Figure 3-22.

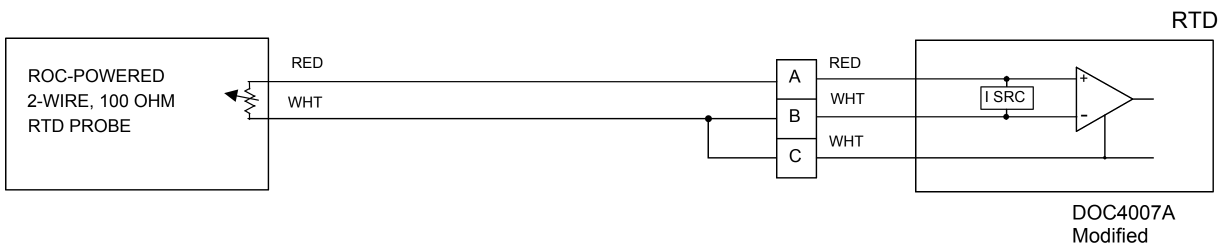


Figure 3-22. RTD Input Module Field Wiring for Two-Wire RTDs

Three-wire RTDs have an active element loop and a compensation loop. The active element loop connects across terminals A and B. The compensation loop connects across B and C. The compensation loop helps increase the accuracy of the temperature measurement by allowing the RTD module to compensate for the resistance of hookup wire used between the probe and RTD module.

In operation, the RTD module subtracts the resistance between terminals B and C from the resistance between terminals A and B. The remainder is the resistance of only the active element of the probe. This compensation becomes more important as the resistance of the hookup wire increases with distance between the probe and the FloBoss. Of course, in order to perform properly, the compensation loop must use the same type, size, and length of hookup wire as the active element loop.

The RTD module is designed for only one compensation loop, and this loop is not isolated from the active element loop because terminal B is common to both loops. In the 3-wire RTD, the wires connect to module terminals A, B, and C, as shown in Figure 3-23.

It is important to match the color-coding of the RTD probe wires to the proper module terminal, because the probe wire colors vary between manufacturers. To determine which leads are for the compensation loop and which are for the active element, read the resistance across the probe wires with an ohmmeter. The compensation loop reads 0 ohms, and the RTD element reads a resistance value matching the temperature curve of the RTD.

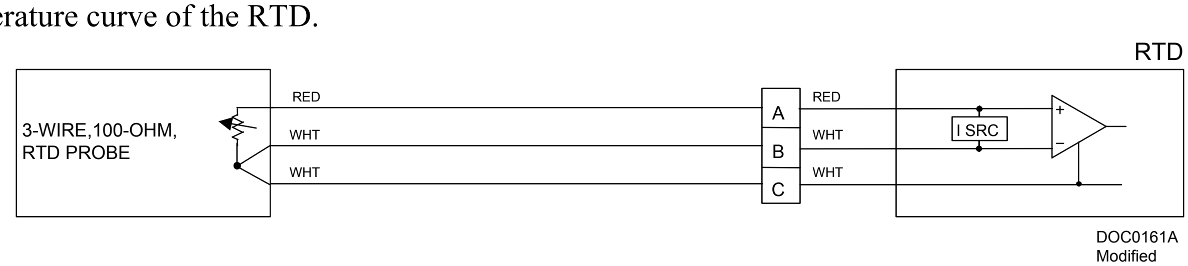


Figure 3-23. RTD Input Module Field Wiring for Three-Wire RTDs

RTDs with four wires normally have the compensation loop separate from the active element loop to increase the accuracy of the probe. Various colors are used for the probe wires. For example, some probes have wire colors of red and white for the RTD element loop and black leads for the compensation loop, while other probes use two red leads for the active element loop and two white leads for the compensation loop.

The connections in Figure 3-24 connect a 4-wire RTD with compensation loop to the 3-wire RTD module. The RTD module designed for 3-wire use does not permit a 4-wire RTD to provide any additional accuracy over a 3-wire RTD.

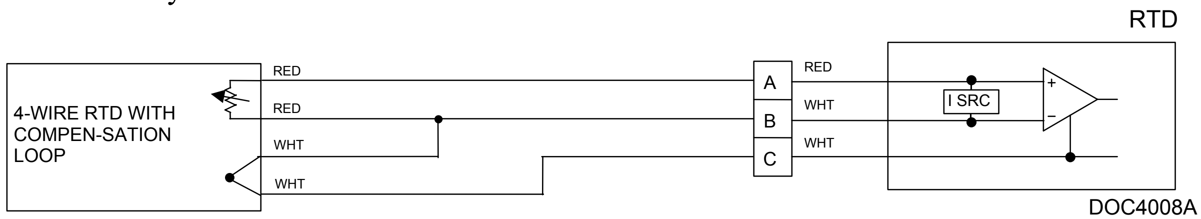


Figure 3-24. RTD Input Module Field Wiring for Four-Wire RTD With Compensation Loop

Figure 3-25 shows the connections for a single-element, 4-wire RTD. The two leads for one side of the RTD are both red, and for the other side, they are both white.

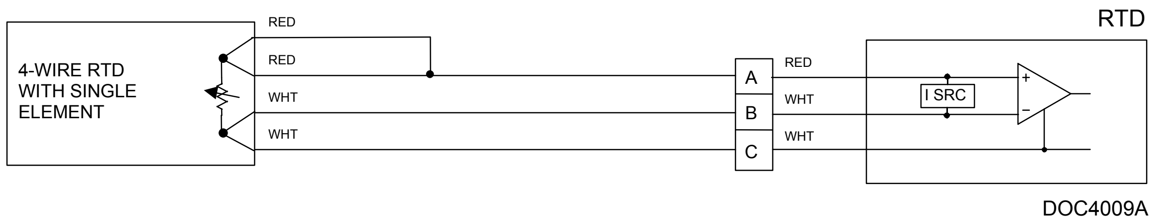


Figure 3-25. Field Wiring for Four-Wire, Single Element RTD

3.4.16 HART Interface Module

The HART Interface module allows the FloBoss to interface with up to ten Highway Addressable Remote Transducer (HART) devices per I/O slot. The HART module provides “loop source” power (+T) on terminal A and two channels for communications on terminals B and C. The +T power is regulated by a current limit. If the power required by all connected HART devices exceeds 40 milliamps (more than an average of 4 milliamps each), the total number of HART devices must be reduced.

The HART module polls one channel at a time. If more than one device is connected to a channel in a multi-drop configuration, the module polls all devices on that channel before it polls the second channel. The HART protocol allows one second per poll for each device, so with five devices per channel the entire poll time for the module would be ten seconds.

In a point-to-point configuration, only one HART device wires to each HART module channel. In a multi-drop configuration, two to five HART devices can connect to a channel.

In either case, terminal A (+T) is wired in parallel to the positive (+) terminal on all of the HART devices, regardless of the channel to which they are connected. Channel 1 (terminal B) is wired to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of two to five devices. Likewise, channel 2 (terminal C) is wired to the negative (–) terminal of a single HART device, or in parallel to the negative terminals of a second group of two to five devices. Refer to Figure 3-26.

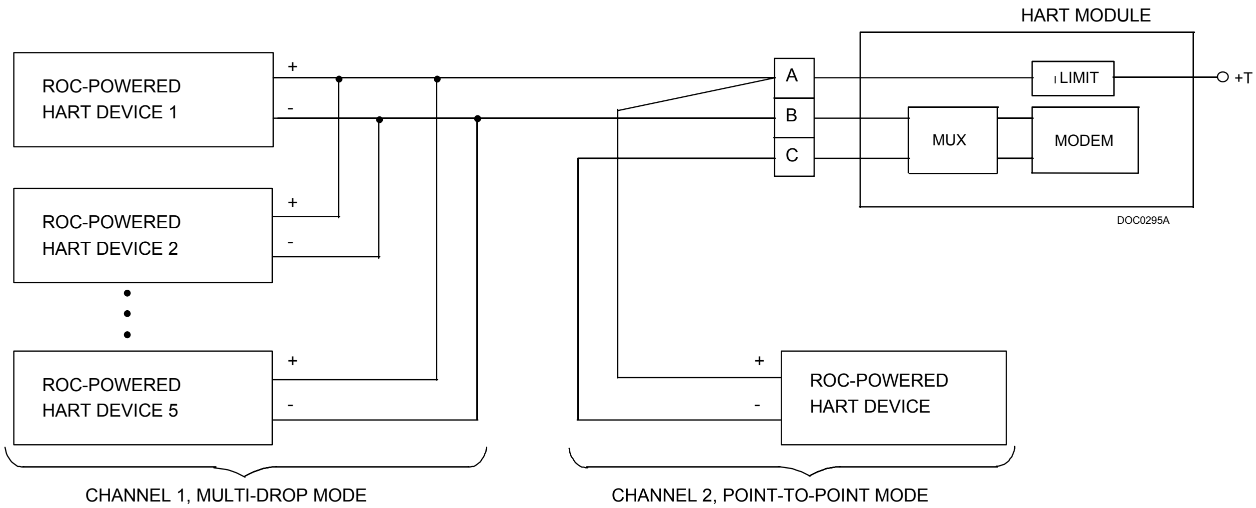


Figure 3-26. Field Wiring for a HART Interface Module

3.5 Troubleshooting and Repair

Use troubleshooting and repair to identify and replace faulty modules. Faulty modules must be returned to your local sales representative for repair or replacement.

If an I/O point does not function correctly, first determine if the problem is with the field device or the I/O module as follows:

CAUTION

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

1. Isolate the field device from the FloBoss by disconnecting it at the I/O module terminal block.
2. Connect the FloBoss to a computer running ROCLINK configuration software.
3. Perform the appropriate test procedure described in the following sections.

A module suspected of being faulty should be checked for a short circuit between its input or output terminals and the ground screw. If a terminal not directly connected to ground reads zero (0) when measured with an ohmmeter, the module is defective and must be replaced.

3.5.1 Analog Input Modules

Equipment Required: Multimeter

To determine if an Analog Input module is operating properly, its configuration must first be known. Table 3-2 shows typical configuration values for an Analog Input:

Table 3-2. Analog Input Module Typical Configuration Values

Parameter	Value	Corresponds To
Adjusted A/D 0 %	800	1 volt dc across scaling resistor R_s
Adjusted A/D 100 %	4000	5 volts dc across R_s
Low Reading EU	0.0000	EU value with 1 volt dc across R_s
High Reading EU	100.0	EU value with 5 volts dc across R_s
Filter EUs	xxxxx	Value read by AI module

When the value of Filtered Engineering Units (EU) is –25% of span as configured above, it is an indication of no current flow (0 milliamps), which can result from open field wiring or a faulty field device.

When the value of Filtered EUs is in excess of 100% of span as configured above, it is an indication of maximum current flow, which can result from shorted field wiring or a faulty field device.

When the value of Filtered EUs is between the low and high readings, you can verify the accuracy of the reading by measuring the voltage across scaling resistor R_s (V_{rs}) with the multimeter. To convert this reading to the filtered EUs value, perform the following:

$$\text{Filtered EUs} = [((V_{rs} - 1) \div 4) \times \text{Span}] + \text{Low Reading EU},$$

$$\text{where Span} = \text{High Reading EU} - \text{Low Reading EU}$$

This calculated value should be within one-tenth of one percent of the Filtered EUs value measured by the FloBoss. To verify an accuracy of 0.1 percent, read the loop current with a multimeter connected in series with current loop. Be sure to take into account that input values can change rapidly, which can cause a greater error between the measured value and the calculated value.

If the calculated value and the measured value are the same, the AI module is operating correctly.

3.5.2 Analog Output Modules

The Analog Output module is a source for current loop or voltage devices. Two test procedures are provided to verify correct operation.

- ♦ Check AO Current Loop Source Installations on page 3-25.
- ♦ Check AO Voltage Source Installations on page 3-25.

3.5.2.1 Check AO Current Loop Source Installations

Equipment Required: Multimeter
Personal Computer running ROCLINK configuration software

1. Taking appropriate precautions, disconnect the field wiring going to the AO module terminations.
2. Connect a multimeter between the B and C terminals of the module and set the multimeter to measure current in milliamps.
3. Using ROCLINK configuration software, put the AO point associated with the module under test in Manual mode (Scanning Disabled).
4. Set the output to the High Reading EU value.
5. Verify a 20-milliamps reading on the multimeter.
6. Calibrate the Analog Output High Reading EU value by increasing or decreasing the "Adjusted D/A 100%" value.
7. Set the output to the Low Reading EU value.
8. Verify a 4-milliamps reading on the multimeter.
9. Calibrate the Analog Output Low Reading EU value by increasing or decreasing the "Adjusted D/A 0%" value.
10. Enable scanning (Scanning Enabled or Auto) for the AO point, remove the test equipment, and reconnect the field device.
11. If possible, verify the correct operation of the AO module by setting the High Reading EU and Low Reading EU values as before (Scanning Disabled) and observing the field device.

3.5.2.2 Check AO Voltage Source Installations

Equipment Required: Multimeter
Personal Computer running ROCLINK configuration software

To check operation of the Analog Output module powering a voltage device:

1. If the resistance value (R) of the field device is known, measure the voltage drop (V) across the device and calculate the output EU value using the following formula.

   $$\text{EU value} = [((1000V/R - 4) \div 16) \times \text{Span}] + \text{Low Reading EU},$$

   where Span = High Reading EU – Low Reading EU

2. Compare the computed value to the output EU value measured by the FloBoss with ROCLINK configuration software. It is normal for the reading to be several percent off, depending on the accuracy tolerance of the device and how rapidly changes occur in the output value.
3. Calibrate the Analog Output EU values by increasing or decreasing the "Adjusted D/A % Units."
4. If the Analog Output is unable to drive the field device to the 100% value, confirm the +V (1 to 5 volts) voltage is present at the field device.
   - If the voltage is present and the device is not at the 100% position, the resistance value of the device is too large for the +V voltage. Use a field device with a lower internal resistance.
   - If the voltage is not present at the field device, but it is present at field wiring terminal B, there is excessive resistance or a break in the field wiring.

3.5.3 Discrete Input Source Module

Equipment Required: Jumper wire

1. Place a jumper across terminals B and C.
2. The LED on the module should light and the Status as read by ROCLINK configuration software should change to "On."
3. With no jumper on terminals B and C, the LED should not be lit and the Status should be "Off."
4. If the unit fails to operate, make sure a correct value for the module resistor is being used.

3.5.4 Discrete Input Isolated Module

Equipment Required: Voltage generator capable of generating 11 to 30 volts dc
Personal Computer running ROCLINK configuration software

1. Supply an input voltage across terminals B and C.
2. The LED on the module should light and the Status as read by ROCLINK configuration software should change to "On."
3. With no input on terminals B and C, the LED should not be lit and the Status should be "Off."
4. If the unit fails to operate, make sure a correct value for the module resistor is being used.

3.5.5 Discrete Output Source Module

Equipment Required: Multimeter
Personal Computer running ROCLINK configuration software

1. Place the Discrete Output in manual mode (Scanning Disabled) using ROCLINK configuration software.
2. With the output Status set to "Off," less than 0.5 volts dc should be measured across pins B and pin C.
3. With the output Status set to "On," approximately 1.5 volts dc less than the system voltage (V_s–1.5) should be measured across terminals A and B.
4. If these values are not measured, check to see if the module fuse is open, verify the module is wired correctly, and verify the load current requirement does not exceed the 57-milliamps current limit value of the module.

3.5.6 Discrete Output Isolated Module

Equipment Required: Multimeter
Personal Computer running ROCLINK configuration software

1. Place the Discrete Output in manual mode (Scanning Disabled) using ROCLINK configuration software.
2. Set the output Status to "Off" and measure the resistance across terminals A and B. No continuity should be indicated.
3. Set the output Status to "On" and measure the resistance across terminals A and B. A reading of 15 kilohms or less should be obtained.

3.5.7 Discrete Output Relay Module

Equipment Required: Multimeter
Personal Computer running ROCLINK configuration software

1. Place the Discrete Output in manual mode (Scanning Disabled) using ROCLINK configuration software.
2. Set the output Status to "Off" and measure the resistance across terminals B and C. A reading of 0 ohms should be obtained.
3. Measure the resistance across terminals A and B. No continuity should be indicated.
4. Set the output Status to "On" and measure the resistance across terminals B and C. No continuity should be indicated.
5. Measure the resistance across terminals A and B. A reading of 0 ohms should be obtained.

3.5.8 Pulse Input Source and Isolated Modules

Equipment Required: Pulse Generator
Voltage Generator
Frequency Counter
Jumper wire

For both types of modules, there are two methods of testing.

- Testing Pulse Input High-Speed Operation on page 3-28.
- Testing Pulse Input Low-Speed Operation on page 3-28.

❖ **NOTE:** When checking the operation of the Pulse Input Source and Isolated modules, ensure the scan rate for the Pulse Input is once every 6.5 seconds or less as set by ROCLINK configuration software.

3.5.8.1 Testing Pulse Input High-Speed Operation

To verify high-speed operation:

1. Connect a pulse generator having sufficient output to drive the module to terminals B and C.
2. Connect a frequency counter across terminals B and C.
3. Set the pulse generator to a value equal to, or less than 10 kilohertz.
4. Set the frequency counter to count pulses.
5. Verify the count read by the counter and the total accumulated count (Accumulated Pulses) read by the FloBoss are the same using ROCLINK configuration software.

3.5.8.2 Testing Pulse Input Low-Speed Operation

To verify low-speed operation of the **PI Source** module:

1. Alternately jumper across terminals B and C.
2. The module LED should cycle on and off, and the total accumulated count (Accumulated Pulses) should increase.

To verify low-speed operation of the **PI Isolated** module:

1. Alternately supply and remove an input voltage across terminals B and C.
2. The module LED should cycle on and off, and the total accumulated count (Accumulated Pulses) should increase.

3.5.9 Slow Pulse Input Source Module

Equipment Required: Jumper wire

To verify low-speed operation of the PI Source module:

1. Connect and remove a jumper across terminals B and C several times to simulate slow switching.
2. The module LED should cycle on and off and the total accumulated count (Accumulated Pulses) should increase.

3.5.10 Slow Pulse Input Isolated Module

Equipment Required: Jumper wire

To verify low-speed operation of the PI Isolated module:

1. Alternately supply and remove an input voltage across terminals B and C.
2. The module LED should cycle on and off and the total accumulated count (Accumulated Pulses) should increase.

3.5.11 Low-Level Pulse Input Module

Equipment Required: Pulse Generator
Frequency Counter
Personal Computer running ROCLINK configuration software

❖ **NOTE:** When checking the operation of the Low-Level Pulse Input module, ensure that the Scan Period for the Pulse Input is once every 22 seconds or less as set by ROCLINK configuration software.

To verify operation:

1. Connect a pulse generator, with the pulse amplitude set at less than 3 volts, to terminals B and C.
2. Connect a frequency counter across terminals B and C. Set the pulse generator to a value equal to or less than 3 kilohertz.
3. Set the frequency counter to count pulses.
4. Verify that the count read by the counter and in the total accumulated count (Accumulated Pulses) read by the FloBoss are the same using ROCLINK configuration software.

3.5.12 RTD Input Module

The RTD module is similar in operation to an AI module and uses the same troubleshooting and repair procedures. The RTD module can accommodate two-wire, three-wire, or four-wire RTDs. If two-wire RTDs are used, terminals B and C must be connected together. If any of the input wires are broken or not connected, ROCLINK configuration software indicates the "Raw A/D Input" value is either at minimum (less than 800) or maximum (greater than 4000) as follows:

- An open at terminal A gives a maximum reading.
- An open at terminal B gives a minimum reading.
- An open at terminal C gives a minimum reading.

To verify the operation of the RTD module:

1. Disconnect the RTD and connect a jumper between terminals B and C of the RTD module.
2. Connect an accurate resistor or decade resistance box with a value to give a low end reading across terminals A and B. The resistance value required can be determined by the temperature-to-resistance conversion chart for the type of RTD being used.
3. Use ROCLINK configuration software to verify that the Raw A/D Input value changed and reflects the Adjusted A/D 0% value.
4. Change the resistance to reflect a high temperature as determined by the temperature-to-resistance conversion chart.
5. Verify that the Raw A/D Input value changed and reflects the Adjusted A/D 100% value.

3.5.13 HART Interface Module

The HART Interface Module provides the source for the HART devices and uses two test procedures to verify correct operation.

- Verify HART Integrity of Loop Power on page 3-30.
- Verify HART Communications on page 3-30.

3.5.13.1 Verify HART Integrity of Loop Power

Equipment Required: Multimeter

1. Measure voltage between terminals A and B to verify channel 1.
2. Measure voltage between terminals A and C to verify channel 2.
3. The voltage read in both measurements should reflect the value of +T less the voltage drop of the HART devices. Zero voltage indicates an open circuit in the I/O wiring, a defective HART device, or a defective module.

3.5.13.2 Verify HART Communications

Equipment Required: Dual-trace Oscilloscope

In this test, the HART module and the FloBoss act as the host and transmit a polling request to each HART device. When polled, the HART device responds. Use the oscilloscope to observe the activity on the two HART communication channels. There is normally one second from the start of one request to the start of the next request.

1. Attach one input probe to terminal B of the HART module and examine the signal for a polling request and response for each HART device connected to this channel.
2. Attach the other input probe to terminal C and examine the signal for a polling request and response for each HART device connected.
3. Compare the two traces. Signal bursts should not appear on both channels simultaneously.

Each device on one channel is polled before the devices on the other channel are polled. If a channel indicates no response, this could be caused by faulty I/O wiring or a faulty device. If the HART module tries to poll both channels simultaneously, this could be caused by a defective module, in which case the module must be replaced.

3.6 Removal, Addition, and Replacement Procedures

Use the following when removing, adding, or replacing I/O modules.

3.6.1 Impact on I/O Point Configuration

When an I/O module is replaced with the **same type** of I/O module, it is not necessary to reconfigure the FloBoss. Modules that are treated as the same type include:

- Discrete Input Isolated and DI Source Modules.
- Discrete Output Isolated, DO Source, and DO Relay Modules.
- Analog Input Loop, AI Differential, AI Source Modules, and RTD Input Modules.
- Pulse Input Isolated and PI Source Modules.
- Slow Pulse Input Isolated and SPI Source Modules.

If a module is to be replaced with one of the same type, but configuration parameters need to be changed, use ROCLINK configuration software to make the changes off-line or on-line. To minimize “down time” before you replace the module, perform changes (except for FloBoss Display and FST changes) off-line by first saving the FloBoss configuration to disk. Modify the disk configuration, replace the module, and then load the configuration file into the FloBoss.

To make changes on-line, replace the module, proceed directly to the configuration display for the affected point, and modify parameters as needed. Remember to consider the impact on FSTs and other points that reference the affected point.

Any added modules (new I/O points) start up with default configurations. Even though adding a module, removing a module, or moving a module to a new position in the FloBoss does not directly affect the configuration of other I/O points, it **can affect the numbering of I/O points of the same type**. This, in turn, can impact an FST or higher-level point because the referencing of I/O points is done by a sequence-based point number.

For example, if you have AI modules installed in slots A7, A10, and A11, adding another AI module in slot A8 changes the point numbers of the Analog Inputs for modules in slots A10 and A11.

CAUTION

If one or more FSTs, or higher level points, such as a PID loop or AGA Flow, have been configured in the FloBoss, be sure to reconfigure them according to the changes in I/O modules. Operational problems will occur if you do not reconfigure the FloBoss.

3.6.2 Removing and Installing an I/O Module

Use the following procedure to remove/install an I/O module with the FloBoss power off. The procedure is performed using ROCLINK configuration software.

⚠ CAUTION

There is a possibility of losing the FloBoss configuration and historical data held in RAM while performing the following procedure. As a precaution, save the current configuration and historical data to permanent memory as instructed in Section 2, Troubleshooting and Repair.

⚠ CAUTION

Change components only in an area known to be non-hazardous.

⚠ CAUTION

Failure to exercise proper electrostatic discharge precautions (such as wearing a grounded wrist strap) may reset the processor or damage electronic components, resulting in interrupted operations.

⚠ CAUTION

During this procedure all power will be removed from the FloBoss and devices powered by the FloBoss. Ensure that all connected input devices, output devices, and processes remain in a safe state when power is removed from the FloBoss and when power is restored to the FloBoss.

1. Perform a RAM backup as in Section 2, Troubleshooting and Repair.
2. Disconnect the input power by unplugging the 5-terminal connector.
3. Perform one of the following steps, depending on whether the module is to be removed or installed:
   - If removing the module, loosen the module retaining screw and remove the module by lifting straight up. It may be necessary to rock the module gently while lifting.
   - If installing the module, insert the module pins into the module socket. Press the module firmly in place. Tighten the module retaining screw. Refer to Section 3.6.1, Impact on I/O Point Configuration, on page 3-30.
4. After the module is removed/installed, reconnect the input power.

5. Check the configuration data, FloBoss Displays, and FSTs, and load or modify them as required. Load and start any user programs as needed.
6. If you changed the configuration, save the current configuration data to memory by selecting FloBoss > Flags > Write to EEPROM or Flash Memory Save Configuration as instructed in the applicable ROCLINK configuration software user manual.
7. If you changed the configuration, including the history database, FSTs, and FloBoss Displays, save them to disk. Refer to Section 2, Troubleshooting and Repair, for more information on performing saves.

3.7 I/O Module Specifications

The specifications for the various I/O modules are given in this section.

3.7.1 Analog Input Modules—Loop and Differential

Analog Input Loop Module Specifications	
FIELD WIRING TERMINALS **A:** Loop Power (+T). **B:** Analog Input (+). **C:** Common (–). **INPUT** **Type:** Single-ended, voltage sense. Current loop with scaling resistor (R1). **Loop Current:** 0 to 25 mA maximum range. Actual range depends on scaling resistor used. **Voltage Sensing:** 0 to 5 V dc, software configured. **Accuracy:** 0.1% of full scale at 20 to 30°C (68 to 86°F). 0.5% of full scale at –40 to 70°C (–40 to 158°F).	**INPUT (CONTINUED)** **Impedance:** Greater than 400 kΩ (without scaling resistor). **Normal Mode Rejection:** 50 dB @ 60 Hz. **POWER REQUIREMENTS** **Loop Source:** 25 mA maximum, from FloBoss power supply (V_s = 11 to 30 V dc). **Module:** 4.9 to 5.1 V dc, 6 mA maximum; –4.5 to –5.5 V dc, 2 mA maximum (supplied by FloBoss). **ISOLATION** Not isolated. Terminal C tied to power supply common.

Analog Input Differential Module Specifications	
FIELD WIRING TERMINALS **A:** Not used. **B:** Positive Analog Input (+). **C:** Negative Analog Input (–). **INPUT** **Type:** Voltage sense. Externally-powered current loop sensing with scaling resistor (R1). **Voltage:** 0 to 5 V dc, software configured. **Accuracy:** 0.1% of full scale at 20 to 30°C (68 to 86°F). 0.5% of full scale at –40 to 70°C (–40 to 158°F).	**INPUT (CONTINUED)** **Normal Mode Rejection:** 50 dB @ 60 Hz. **Impedance:** Greater than 400 kΩ (without scaling resistor). **POWER REQUIREMENTS** 4.9 to 5.1 V dc, 6 mA maximum; –4.5 to –5.5 V dc, 2 mA maximum (supplied by FloBoss). **INPUT ISOLATION** Greater than 400 kΩ input to power supply common.

Analog Input Modules—Loop and Differential Common Specifications

SCALING RESISTOR
250 Ω (supplied) for 0 to 20 mA full scale. 100 Ω for 0 to 50 mA (externally-powered only).

RESOLUTION
12 bits.

FILTER
Single pole, low-pass, 40-ms time constant.

CONVERSION TIME
30 μs typical.

VIBRATION
20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F.

MECHANICAL SHOCK
1500 Gs 0.5 ms half sine per MIL-STD-202 method 213, condition F.

CASE
Solvent-resistant thermoplastic polyester, meets UL94V-0.
Dimensions are 15 mm D by 32 mm H by 43 mm W (0.60 in. D by 1.265 in. H by 1.69 in. W), not including pins.

ENVIRONMENTAL
Meets the Environmental specifications of the FloBoss, in which the module is installed, including Temperature, Humidity, and Transient Protection specifications.

WEIGHT
37 g (1.3 oz).

APPROVALS
Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.2 Analog Input Source Module

Analog Input Source Specifications

FIELD WIRING TERMINALS
A: 10 V dc.
B: Analog Input.
C: Common.

INPUT
Type: Single-ended, voltage sense; can be current loop if scaling resistor (not supplied) is used.
Voltage: 0 to 5 V dc, software configurable.
Resolution: 12 bits.
Accuracy: 0.1% of full scale at 20 to 30°C (68 to 86°F). 0.5% of full scale at –40 to 65°C (–40 to 149°F).
Impedance: Greater than 400 kΩ (without scaling resistor).
Normal Mode Rejection: 50 db @ 60 Hz.

SOURCE POWER
9.99 to 10.01 V dc, 20 mA maximum.

POWER REQUIREMENTS
4.9 to 5.1 V dc, 6 mA maximum; –4.5 to –5.5 V dc, 2 mA maximum (all supplied by FloBoss).

INPUT ISOLATION
Not isolated. Terminal C is tied to power supply ground.

SURGE WITHSTAND
Meets IEEE 472 / ANSI C37.90a.

FILTER
Single pole, low-pass, 40 ms time constant.

CONVERSION TIME
30 μs typical.

VIBRATION
20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F.

MECHANICAL SHOCK
1500 Gs 0.5 ms half sine per MIL-STD-202, method 213, condition F.

CASE
Solvent-resistant thermoplastic polyester, meets UL94V-0. Dimensions 15 mm D by 32 mm H by 43 mm W (0.6 in. D by 1.265 in. H by 1.690 in. W), not including pins.

ENVIRONMENTAL
Meets the Environmental specifications of the FloBoss, in which the module is installed, including Temperature, Humidity, and Transient Protection.

WEIGHT
37 g (1.3 oz).

APPROVALS
Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.3 Analog Output Source Module

Analog Output Source Specifications

FIELD WIRING TERMINALS
A: Voltage Output.
B: Current Output.
C: Common.

VOLTAGE OUTPUT
Type: Voltage source.
Range: 1 to 5 V dc with 0 to 5.25 V dc overranging. 25 mA maximum.
Resolution: 12 bits.

VOLTAGE OUTPUT (CONTINUED)
Accuracy: 0.1% of full-scale output from 20 to 30°C (68 to 86°F). 0.5% of full-scale output for –40 to 65°C (–40 to 149°F).
Settling Time: 100 μs maximum.
Reset Action: Output returns to zero percent output or last value (software configurable) on power-up (Warm Start) or on watchdog timeout.

Analog Output Source Specifications (Continued)

CURRENT OUTPUT

Type: Current loop.

Range: 4 to 20 mA with 0 to 22 mA overranging, adjusted by scaling resistor. A 0 Ω resistor is supplied.

Loop Source: 11 to 30 V dc, as supplied by FloBoss for "+T" power (typically 24 V dc).

Loop Resistance at 12 V dc: 0 Ω minimum, 250 Ω maximum.

Loop Resistance at 24 V dc: 200 Ω minimum, 750 Ω maximum.

Resolution: 12 bits.

Accuracy: 0.1% of full-scale output at 20 to 30°C (68 to 86°F). 0.5% of full-scale at –40 to 65°C (–40 to 149°F).

Settling Time: 100 μs maximum.

Reset Action: Output returns to zero percent output or last value (software configurable) on power-up (Warm Start) or on watchdog timeout.

POWER REQUIREMENTS

Module Alone: 24 mW typical.

Module w/Current Loop: 400 mW @ 4 mA output to 590 mW @ 20 mA output.

OUTPUT ISOLATION

Not isolated. Terminal C tied to power supply common.

VIBRATION

20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F.

MECHANICAL SHOCK

1500 Gs 0.5 ms half sine per MIL-STD-202, method 213, condition F.

WEIGHT

37 g (1.3 oz) typical.

CASE

Solvent-resistant thermoplastic polyester, meets UL94V-0.
Dimensions are 15 mm by 32 mm by 43 mm (0.6 in. D by 1.265 in. H by 1.69 in. W), not including pins.

ENVIRONMENTAL

Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Transient Protection.

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.4 Discrete Input Modules—Source and Isolated

Discrete Input Source Module Specifications

FIELD WIRING TERMINALS

A: Not used.

B: Discrete device source/signal.

C: Common.

INPUT

Type: Contact sense.

Range: Inactive: 0 to 0.5 mA. Active: 2 to 9 mA.

Source Voltage: 11 to 30 V dc.

Source Current: Determined by source voltage (Vs), loop resistance (Rl), and scaling resistor (Rs, 10 Ω supplied):

I = (Vs – 1)/(3.3K + Rl + Rs)

POWER REQUIREMENTS

Source Input: 9 mA maximum from FloBoss power supply.

Module: 4.9 to 5.1 V dc, 1 mA maximum (supplied by FloBoss).

INPUT ISOLATION

Not isolated. Terminal C tied to power supply common.

Discrete Input Isolated Module Specifications	
FIELD WIRING TERMINALS **A:** Not used. **B:** Positive Discrete Input. **C:** Negative Discrete Input. **INPUT** **Type:** Two-state current sense. **Range:** Inactive: 0 to 0.5 mA. Active: 2 to 9 mA. **Current:** Determined by input voltage (Vi), loop resistance (Rl), and scaling resistor (Rs), 10 Ω supplied): I = (Vi – 1)/(3.3K + Rl + Rs) **Maximum Voltage:** 30 V dc forward, 5 V dc reverse.	**POWER REQUIREMENTS** 4.9 to 5.1 V dc, 1 mA maximum (supplied by FloBoss). **INPUT ISOLATION** **Isolation:** 100 Ω minimum, input to output, and input or output to case. **Voltage:** 4,000 V ac (RMS) minimum, input to output. **Capacitance:** 6 pF typical, input to output.

Discrete Input Modules—Source and Isolated Common Specifications	
INPUT **Loop Resistance (Rl):** 4.5 kΩ maximum. **Frequency Response:** 0 to 10 Hz maximum, 50% Duty Cycle. **Input Filter (Debounce):** Software filter is configured as the amount of time that the input must remain in the active state to be recognized. **VIBRATION** 20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F. **MECHANICAL SHOCK** 1500 Gs 0.5 ms half sine per MIL-STD-202 method 213, condition F.	**WEIGHT** 37 g (1.3 oz). **CASE** Solvent-resistant thermoplastic polyester, meets UL94V-0. Dimensions are 15 mm D by 32 mm H by 43 mm W (0.60 in. D by 1.27 in. H by 1.69 in. W), not including pins. **ENVIRONMENTAL** Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Transient Protection. **APPROVALS** Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.5 Discrete Output Modules—Source and Isolated

Discrete Output Source Module Specifications

FIELD WIRING TERMINALS
A: Not used.
B: Positive (to field device).
C: Negative.

OUTPUT
Type: Solid-state relay, current sourced, normally-open.
Active Voltage: 11 to 30 V dc provided.
Active Current: Limited to 57 mA.
Inactive Current: Less than 100 μA with 30 V dc source.
Frequency: 0 to 10 Hz maximum.

POWER REQUIREMENTS
Output Source: 11 to 30 V dc, 57 mA maximum from FloBoss power supply.
Module: 4.9 to 5.1 V dc. 1 mA in "Off" state and 6 mA in "On" state.

OUTPUT ISOLATION
Not isolated. Terminal C tied to power supply common.

Discrete Output Isolated Module Specifications

FIELD WIRING TERMINALS
A: Positive (field device power).
B: Negative.
C: Not Used.

OUTPUT
Type: Solid-state relay, normally-open.
Active Voltage: 11 to 30 V dc.
Active Current: Fuse-limited to 1.0 A continuous at 75°C (167°F), externally supplied.
Inactive Current: Less than 100 μA at 30 V dc.
Frequency: 0 to 10 Hz maximum.

POWER REQUIREMENTS
4.9 to 5.1 V dc. 1 mA in "Off" state and 6 mA in "On" state.

OUTPUT ISOLATION
Isolation: 100 MΩ minimum, input to output, and input or output to case.
Voltage: 4,000 V ac (RMS) minimum, input to output.
Capacitance: 6 pF typical, input to output.

Discrete Output Modules—Source and Isolated Common Specifications

VIBRATION
20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F.

MECHANICAL SHOCK
1500 Gs 0.5 ms half sine per MIL-STD-202, method 213, condition F.

CASE
Solvent-resistant thermoplastic polyester, meets UL94V-0.
Dimensions are 15 mm D by 32 mm H by 43 W mm (0.6 in. D by 1.265 in. H by 1.690 in. W), not including pins.

ENVIRONMENTAL
Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Transient Protection.

WEIGHT
37 g (1.3 oz) typical.

APPROVALS
Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.6 Discrete Output Relay Module

Discrete Output Relay Module Specifications

FIELD WIRING TERMINALS

A: Normally-open contacts.
B: Common.
C: Normally-closed contacts.

OUTPUT

Type: SPDT dry relay contact.

Maximum Contact Rating (Resistive Load):
30 V dc, 4 Amps.
125 V ac, 4 Amps.
250 V ac, 2 Amps.

Frequency: 0 to 10 Hz maximum.

OUTPUT ISOLATION

Isolation: 10 MΩ minimum, input to output, and input or output to case.

Voltage: 3,000 V ac (RMS) minimum, input to output.

POWER REQUIREMENTS

12 V dc Version: 4.9 to 5.1 V dc, 1 mA for module. 12 V dc, 25 mA for relay coil (energized) typical.

24 V dc Version: 4.9 to 5.1 V dc, 1 mA for module. 24 V dc, 12.5 mA for relay coil (energized) typical.

VIBRATION

21 G peak or 0.06" double amplitude, 10-2000 Hz per MIL-Std-202, Method 204, Condition F.

MECHANICAL SHOCK

1500 G 0.5 ms half sine per MIL-Std-202, Method 213, Condition F.

WEIGHT

37 g (1.3 oz) typical.

CASE

Solvent-resistant thermoplastic polyester, meets UL94V-0.
Dimensions are 15 mm D by 32 mm H by 43 mm W (0.6 in. D by 1.265 in. H by 1.690 in. W), not including pins.

ENVIRONMENTAL

Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Transient Protection.

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.7 Pulse Input Modules—Source and Isolated

Pulse Input Source Module Specifications

FIELD WIRING TERMINALS

A: Not used.
B: Pulse Input/source voltage.
C: Common.

INPUT

Type: Contact sense.
Source Voltage: 11 to 30 V dc.
Range: Inactive: 0 to 0.5 mA. Active: 3 to 12 mA.
Source Current: Determined by source voltage (Vs), loop resistance (Rl) and scaling resistor (Rs):
I = (Vs – 1)/(2.2K + Rl + Rs)

POWER REQUIREMENTS

Source Input: 11 to 30 V dc, 6 mA maximum from FloBoss power supply.
Module: 4.9 to 5.1 V dc, 1 mA maximum (supplied by FloBoss).

INPUT ISOLATION

Not isolated. Terminal C tied to power supply common.

Pulse Input Isolated Module Specifications	
FIELD WIRING TERMINALS **A:** Not used. **B:** Positive Pulse Input. **C:** Negative Pulse Input. **INPUT** **Type:** Two-state, current-pulse sense. **Range:** Inactive: 0 to 0.5 mA. Active: 3 to 12 mA. **Input Current:** Determined by input voltage (Vi), loop resistance (Rl) and scaling resistor (Rs): $I = (Vi - 1)/(2.2K + Rl + Rs)$	**POWER REQUIREMENTS** 4.9 to 5.1 V dc, 2 mA maximum (supplied by FloBoss). **INPUT ISOLATION** **Isolation:** 100 MΩ minimum, input to output, and input or output to case. **Voltage:** 4,000 V ac (RMS) minimum, input to output. **Capacitance:** 6 pF typical, input to output.

Pulse Input Modules—Source and Isolated Common Specifications	
INPUT **Scaling Resistor (Rs):** 10 Ω supplied (see Input Source Current equation to compute other value). **Frequency Response:** 0 to 12 kHz maximum, 50% Duty Cycle. **Input Filter:** Single-pole low-pass, 10 µs time constant. **VIBRATION** 20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F. **MECHANICAL SHOCK** 1500 Gs 0.5 ms half sine per MIL-STD-202, method 213, condition F.	**WEIGHT** 37 g (1.3 oz). **CASE** Solvent-resistant thermoplastic polyester, meets UL94V-0. Dimensions are 15 mm D by 32 mm H by 43 mm W (0.60 in. D by 1.27 in. H by 1.69 in. W), not including pins. **ENVIRONMENTAL** Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Transient Protection. **APPROVALS** Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.8 Slow Pulse Input Modules—Source and Isolated

Slow Pulse Input Source Module Specifications	
MODULE RACK TERMINALS **A:** Not used. **B:** Input/source voltage. **C:** Common. **INPUT** **Type:** Contact sense. **Range:** Inactive: 0 to 0.5 mA. Active: 2 to 9 mA. **Source Voltage:** 11 to 30 V dc. **Source Current:** Determined by source voltage (Vs), loop resistance (Rl), and scaling resistor (Rs): I = (Vs – 1)/(3.3K + Rl + Rs)	**POWER REQUIREMENTS** **Source Input:** 11 to 30 V dc, 9 mA maximum from FloBoss power supply. **Module:** 4.9 to 5.1 V dc, 1 mA maximum (supplied by FloBoss). **INPUT ISOLATION** Not isolated. Terminal C tied to power supply common.

Slow Pulse Input Isolated Module Specifications	
FIELD WIRING TERMINALS **A:** Not used. **B:** Positive input. **C:** Negative input. **INPUT** **Type:** Two-state current sense. **Range:** Inactive: 0 to 0.5 mA. Active: 2 to 9 mA. **Current:** Determined by input volt-age (Vi), loop resistance (Rl), and scaling resistor (Rs): I = (Vi – 1)/(3.3K + Rl + Rs) **Maximum Voltage:** 30 V dc forward, 5 V dc reverse.	**POWER REQUIREMENTS** 4.9 to 5.1 V dc, 1 mA maximum (supplied by FloBoss). **INPUT ISOLATION** **Isolation:** 100 MΩ minimum, input to output, and input or output to case. **Voltage:** 4,000 V ac (RMS) minimum, input to output. **Capacitance:** 6 pF typical, input to output.

Slow Pulse Input Modules—Source and Isolated Common Specifications	
INPUT **Loop Resistance (Rl):** 4.5 kΩ maximum for best efficiency. **Scaling Resistor (Rs):** 10 Ω supplied (see Input Source Current equation to compute other value). **Frequency Response:** 0 to 10 Hz maximum, 50% Duty Cycle. **Input Filter (Debounce):** 50 ms. **VIBRATION** 20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F. **MECHANICAL SHOCK** 1500 Gs 0.5 ms half sine per MIL-STD-202 method 213, condition F.	**WEIGHT** 37 g (1.3 oz). **CASE** Solvent-resistant thermoplastic polyester, meets UL94V-0. Dimensions 15 mm D by 32 mm H by 43 mm W (0.6 in. D by 1.265 in. H by 1.690 in. W), not including pins. **ENVIRONMENTAL** Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Transient Protection. **APPROVALS** Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.9 Pulse Input Module—Low Level

Pulse Input Module—Low Level Specifications

MODULE RACK TERMINALS

A: Not used.

B: Positive Pulse Input.

C: Negative Pulse Input.

INPUT

Type: Two-state, voltage-pulse sense.

Active Range: 30 mV minimum to 3 V maximum, peak-to-peak.

Frequency Response: 0 to 3 kHz, 50% Duty Cycle.

Impedance: 500 kΩ.

POWER REQUIREMENTS

4.9 to 5.1 V dc, 2 mA maximum (supplied by FloBoss).

INPUT ISOLATION

Isolation: 10 MΩ minimum, input or output to case.

Voltage: 4,000 V ac (RMS) minimum, input to output.

Capacitance: 6 pF typical, input to output.

VIBRATION

20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F.

MECHANICAL SHOCK

1500 Gs 0.5 ms half sine per MIL-STD-202, method 213, condition F.

CASE

Solvent-resistant thermoplastic polyester, meets UL94V-0.

Dimensions 15 mm D by 32 H mm by 43 mm (W 0.60 in. D by 1.27 in. H by 1.69 in. W), not including pins.

WEIGHT

37 g (1.3 oz).

ENVIRONMENTAL

Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Transient Protection.

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

3.7.10 Resistance Temperature Detector (RTD) Input Module

Resistance Temperature Detector (RTD) Input Module Specifications	
FIELD WIRING TERMINALS **A:** RTD “Red” Input. **B:** RTD “White” Input. **C:** RTD “White” Input (3- or 4-wire). **INPUT** **RTD Type:** 100 Ω, platinum, with a temperature coefficient of 0.3850*, 0.3902, 0.3916, 0.3923, or 0.3926 Ω/°C. **Temperature Range:** Fixed at –50 to 100°C (–58 to 212°F). **Excitation Current:** 0.8 mA. **Impedance:** 4 MΩ minimum. **Filter:** Single pole, low pass, 4 Hz corner frequency. **RESOLUTION** 12 bits. **ACCURACY** ± 0.1% of Input Temp. Range at Operating Temp. from 23 to 27°C (73 to 81°F). ± 0.45% of Input Temp. Range at Operating Temp. from 0 to 70°C (32 to 158°F). ± 0.8% of Input Temp. Range at Operating Temp. from –20 to 0°C (–4 to 32°F). **LINEARITY** ± 0.03% ± 1 LSB independent conformity to a straight line.	**POWER REQUIREMENT** 11 to 30 V dc, 38 mA maximum, supplied by FloBoss power supply. **VIBRATION** 20 Gs peak or 0.06 in. double amplitude, 10 to 2,000 Hz, per MIL-STD-202 method 204 condition F. **MECHANICAL SHOCK** 1500 Gs 0.5 ms half sine per MIL-STD-202 method 213, condition F. **ENVIRONMENTAL** Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature and Humidity. **WEIGHT** 37 g (1.3 oz). **CASE** Solvent-resistant thermoplastic polyester, meets UL94V-0. Dimensions are 15 mm D by 32 mm H by 43 mm W (0.60 in. D by 1.265 in. H by 1.69 in. W), not including pins. **APPROVALS** Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

* Available as an accessory.

3.7.11 HART Interface Module

HART Interface Module Specifications

FIELD WIRING TERMINALS

A: Loop Power (+T).
B: Channel 1 (CH1).
C: Channel 2 (CH2).

CHANNELS

Two HART-compatible channels, which communicate via digital signals only.

Mode: Half-duplex.
Data Rate: 1200 bps asynchronous.
Parity: Odd.
Format: 8 bit.
Modulation: Phase coherent, Frequency Shift Keyed (FSK) per Bell 202.
Carrier Frequencies: Mark: 1200 Hz. Space: 2200 Hz, ± 0.1%.

HART MODULES AND DEVICES SUPPORTED

Up to six HART Modules and 32 HART devices maximum.
Point-to-Point Mode: Two HART devices per module (one per channel).
Multi-drop Mode: Up to ten HART devices per module (five per channel).

LOOP POWER

Total power supplied through module for HART devices is 20 mA per channel at 10 to 29 V dc. Each HART device typically uses 4 mA.

POWER REQUIREMENTS

Loop Source: 11 to 30 V dc, 40 mA maximum from FloBoss power supply.
Module: 4.9 to 5.1 V dc, 17 mA maximum.

VIBRATION

20 Gs peak or 0.06 in. double amplitude,
10 to 2,000 Hz, per MIL-STD-202 method 204 condition F.

MECHANICAL SHOCK

1500 Gs 0.5 ms half sine per MIL-STD-202, method 213, condition F.

WEIGHT

48 g (1.7 oz) nominal.

CASE

Solvent-resistant thermoplastic polyester, meets UL94V-0.
Dimensions 15 mm D by 51 mm H by 43 mm W (0.60 in. D by 2.00 in. H by 1.69 in. W), not including pins.

ENVIRONMENTAL

Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Surge specifications.

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

SECTION 4 – COMMUNICATIONS CARDS

4.1 Scope

This section describes the communications cards used with the FloBoss 407 Flow Managers.

This section contains the following information:

4.2 Product Descriptions

The communications cards provide communications between the FloBoss and a host system or external devices. The communications card installs directly onto the processor board and activates the COM2 connector when installed.

The following cards are available:

- ♦ EIA-232 (RS-232) Serial Communications Card.
- ♦ EIA-422/485 (RS-422/485) Serial Communications Card.
- ♦ Radio Modem Communications Card.
- ♦ Leased-Line Modem Communications Card.
- ♦ Dial-Up Modem Communications Card.
- ❖ **NOTE:** Use a standard screwdriver with a slotted (flat bladed) 1/8" width tip when wiring all terminal blocks.

4.2.1 EIA-232 (RS-232) Serial Communications Card

The EIA-232 (RS-232) communications cards meet all EIA-232 (RS-232) specifications for single-ended, asynchronous data transmission over distances of up to 15.24 meters (50 feet). The EIA-232 (RS-232) communications cards provide transmit, receive, and modem control signals. Normally, not all of the control signals are used for any single application. Refer to Figure 4-1.

Refer to Section 4-10, Initial Installation and Setup, on page 4-10 and Section 4.5.1, EIA-232 (RS-232) Communications Card Wiring, on page 4-14.

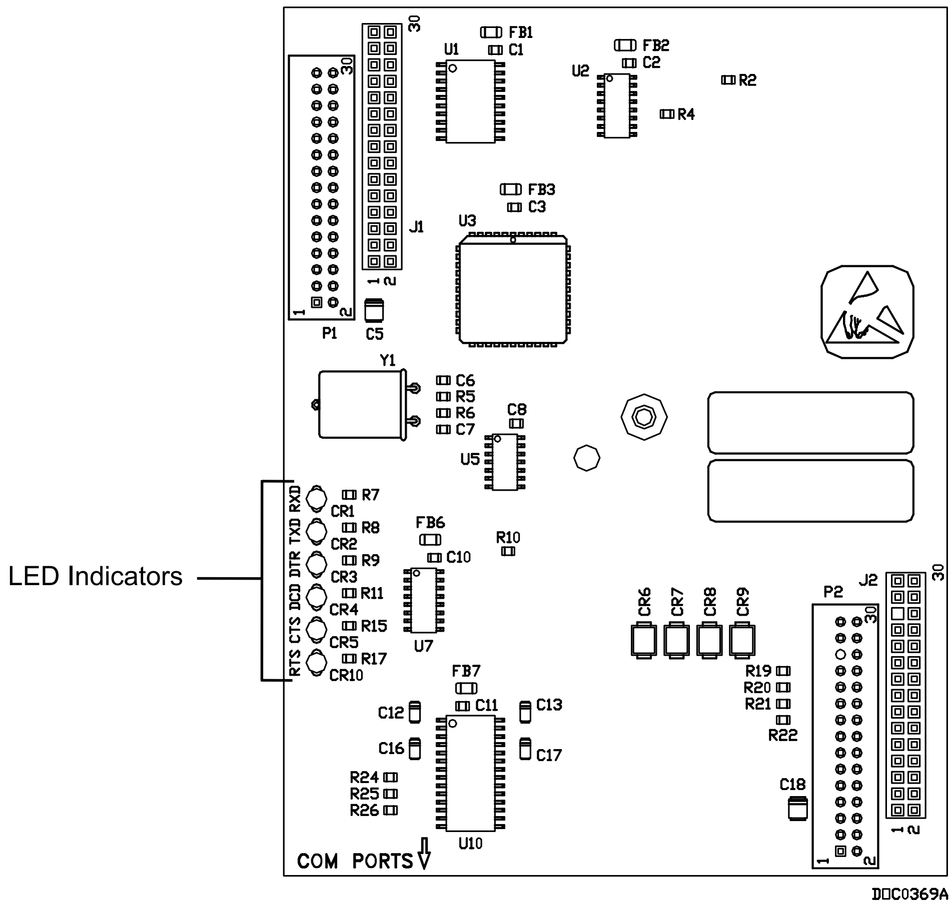


Figure 4-1. EIA-232 (RS-232) Serial Communications Card – Newer

The EIA-232 (RS-233) communications card includes LED indicators along the left-hand side that display the status of the RXD, TXD, DTR, DCD, CTS, and RTS control lines. Refer to Table 4-1.

Table 4-1. Communications Cards LED Indicators

LEDs	Status and Activity
RXD	The RXD **receive data** LED blinks when data is being received. The LED is on for a space and off for a mark.
TXD	The TXD **transmit data** LED blinks when data is being transmitted. The LED is on for a space and off for a mark.
DTR	The DTR **data terminal ready** LED lights when the modem is ready to answer an incoming call. When DTR goes off, a connected modem disconnects.
DCD	The DCD **data carrier detect** LED lights when a valid carrier tone is detected.
CTS	CTS indicates a **clear to send** message.
RTS	The RTS **ready to send** LED lights when the modem is ready to transmit.
RI	The RI is the **ring** indicator LED light.
DSR	The DSR is the **data set ready** indicator LED light.
OH	The OH is the **off hook** indicator LED light. A dial tone has been detected and the telephone line is in use by your modem.
NOTE: The last three LED indicators are used only on the dial-up modem communication card.	

4.3 EIA-422/485 (RS-422/485) Serial Communications Card

The EIA-422/485 (RS-422/485) communication cards (Figure 4-2) meet EIA-422/485 (RS-422/485) specifications for differential, asynchronous transmission of data over distances of up to 1220 meters (4000 feet). The EIA-422 (RS-422) drivers are designed for party-line applications where one driver is connected to, and transmits on, a bus with up to ten receivers. The EIA-485 (RS-485) drivers are designed for true multi-point applications with up to 32 drivers and 32 receivers on a single bus.

❖ **NOTE:** EIA-422 (RS-422) devices should not be used in a true multi-point application where multiple drivers and receivers are connected to a single bus and any one of them can transmit or receive data.

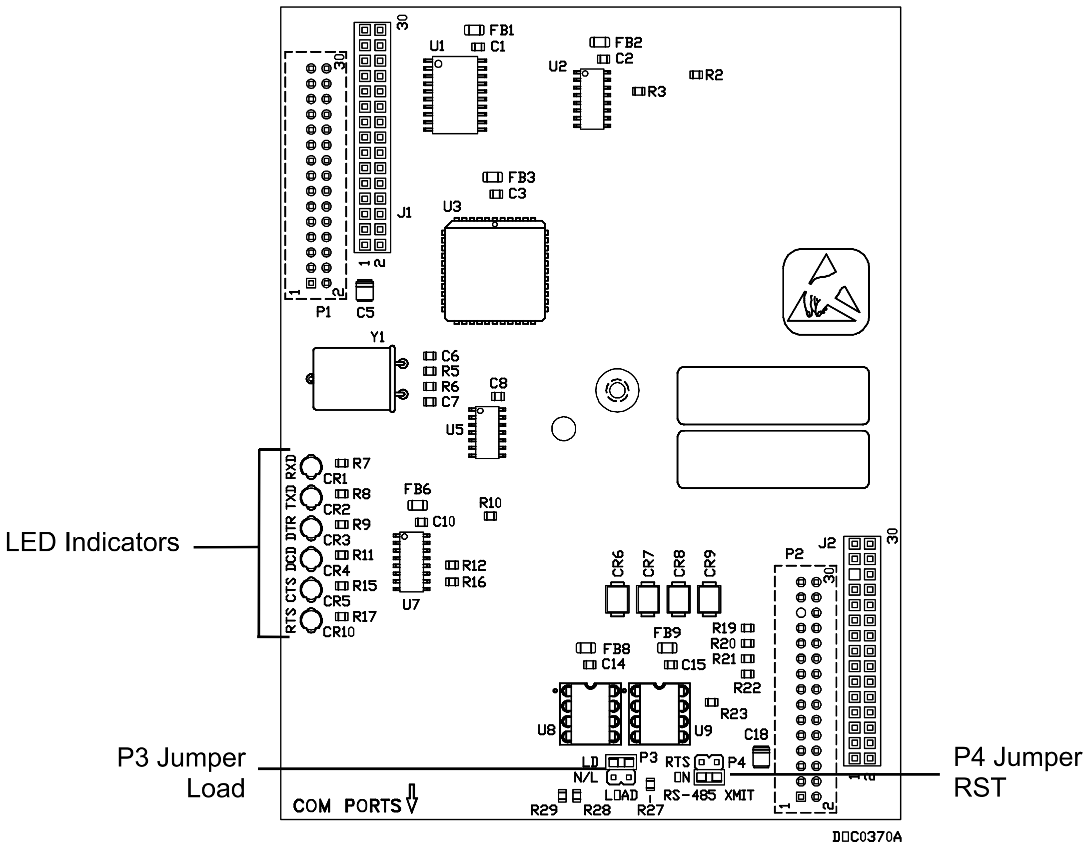


Figure 4-2. EIA-422/485 (RS-422/485) Serial Communications Card – Newer

The EIA-422/485 (RS-422/485) communications card includes LED indicators along the left-hand side display the status of the RXD, TXD, and RTS signal/control lines (DTR, DCD, and CTS are unused). LED indicators are detailed in Table 4-1 on page 4-3.

The jumper P4 (newer card) or P3 (older card) applies to the EIA-422 (RS-422) transmit mode. The default setting (RTS jumper on) allows a multi-drop configuration, such as is normally possible with EIA-485 (RS-485) communications.

The newer card design also includes Load jumper P3 that allows the termination load to remain or to be removed for EIA-485 (RS-485) multi-drop communications.

Refer to Section 4.5.2, EIA-422/485 (RS-422/485) Communications Card Wiring, on page 4-14 for more information.

4.3.1 Radio Modem Communications Card

The Radio Modem Communications Card sends and receives full-duplex or half-duplex, asynchronous Frequency Shift Keyed (FSK) signals to the audio circuit of a two-way radio. The modem incorporates a solid-state push-to-talk (PTT) switch for keying the radio transmitter. Refer to Figure 4-3.

LED indicators on the card show the status of the RXD, TXD, DTR, DCD, CTS, and RTS control lines. Refer to Table 4-1, Communications Cards LED Indicators, on page 4-3.

Jumper P6 determines whether the PTT signal is isolated or grounded. Use connector P7 signals for monitoring or connecting to an analyzer. Refer to Section 4.4.2, Setting Modem Card Jumpers, on page 4-11.

The output attenuation can be reduced to better match the modem output to the line or radio. Plugging a resistor into the card at R2 makes the adjustment. Refer to Section 4.4.3, Setting Modem Card Attenuation Levels, on page 4-12.

Refer to Section 4.5.3, Radio Modem Communications Card Wiring, on page 4-16.

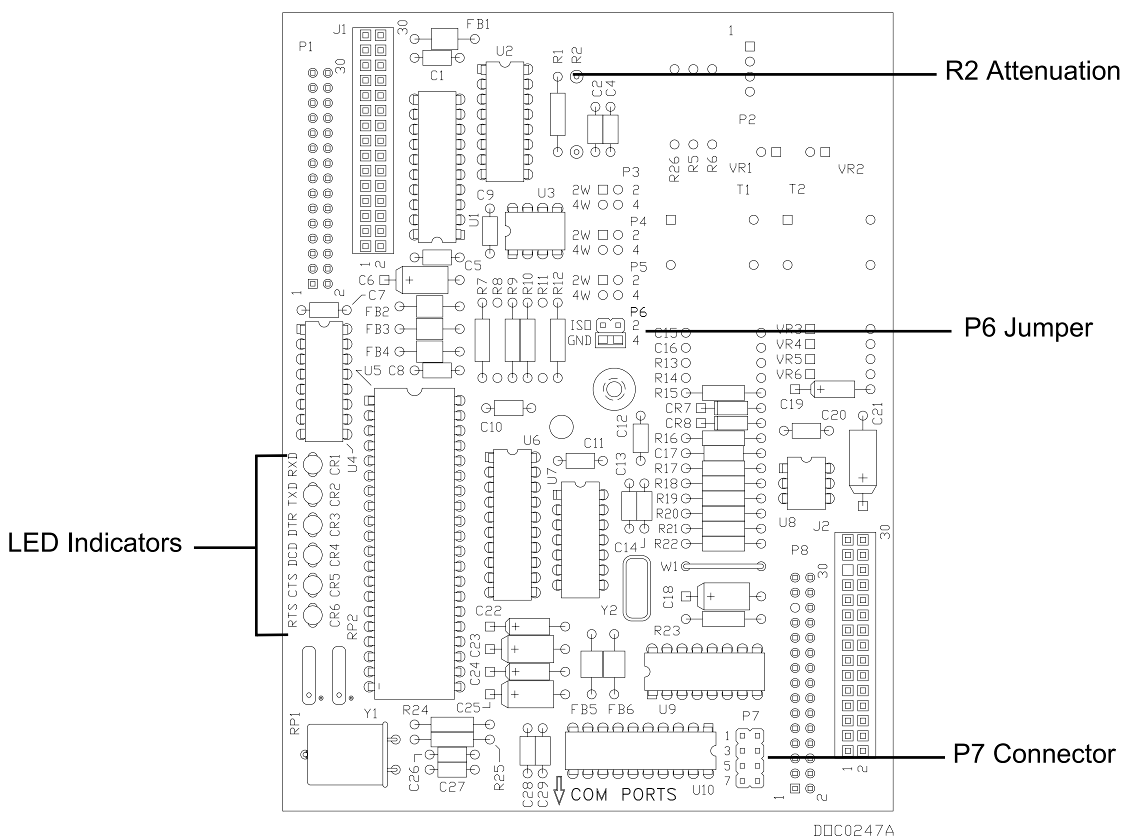


Figure 4-3. Radio Modem Communications Card

4.3.2 Leased-Line Modem Communications Card

The Leased-Line Modem Communications Card is a 202T modem that is FCC part 68 tested for use with leased-line or private-line telephone lines. Refer to Figure 4-4. Two- or four-wire, half or full-duplex asynchronous operation is supported at a software selectable 300, 600, and 1200 baud to Bell and CCITT standards.

LED indicators on the card show the status of the RXD, TXD, DTR, DCD, CTS, and RTS control lines. Refer to Table 4-1, Communications Cards LED Indicators, on page 4-3.

The Leased-Line Modem Communications Card has three jumpers (P3, P4, and P5) that permit either two-wire or four-wire operation. Use connector P7 signals for monitoring or connecting to an analyzer. Refer to Section 4.4.2, Setting Modem Card Jumpers, on page 4-11 for more information.

The output attenuation can be reduced to better match the modem output to the line or radio. Plugging a resistor into the card at R2 makes the adjustment. Refer to Section 4.4.3, Setting Modem Card Attenuation Levels, on page 4-12.

Refer to Section 4.5.4, Leased-Line Communications Card Wiring, on page 4-17.

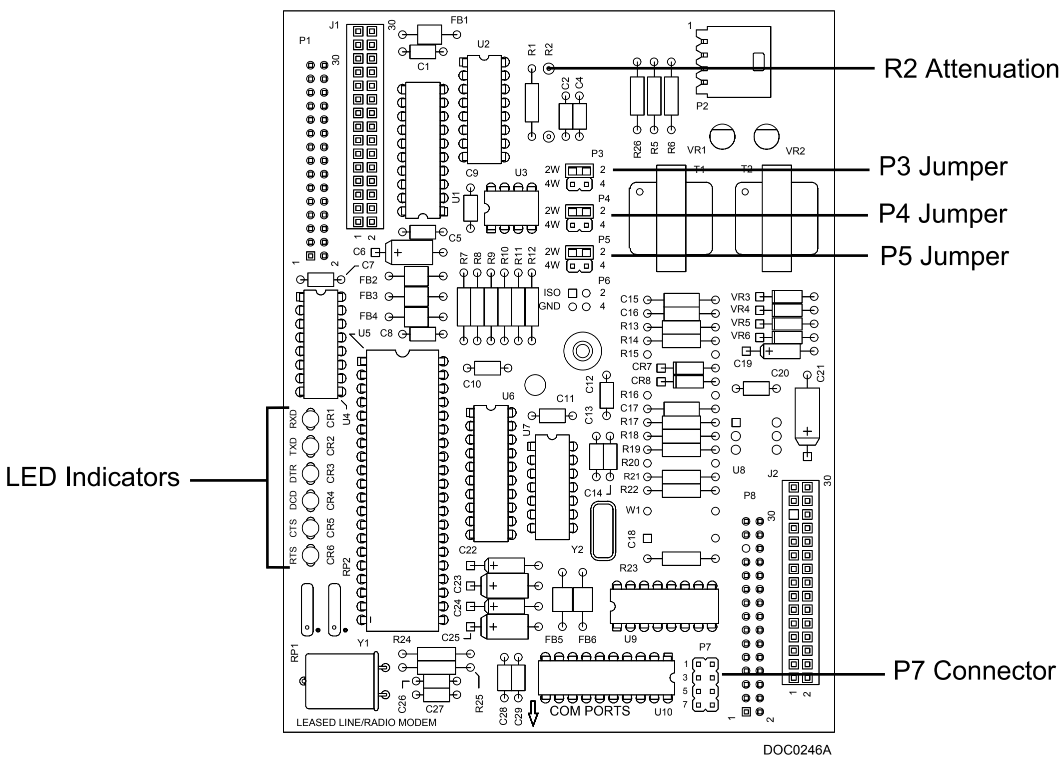


Figure 4-4. Leased-Line Modem Communications Card

4.3.3 Dial-Up Modem Communications Card

The Dial-up Modem Communications Card supports V.32 bis, V.32, V.22 bis, V.22, V.21, Bell 212A and 103 communications with auto-answer/auto-dial features. The modem card is Federal Communications Commission (FCC) part 68 approved for use with public-switched telephone networks (PSTNs). The FCC label on the card provides the FCC registration number and the ringer equivalent. The modem card has automatic adaptive and fixed compromise equalization, eliminating the need to adjust pots or move jumpers during installation and setup. Refer to Figure 4-5.

The modem card interfaces to two-wire, full-duplex telephone lines using asynchronous operation at data rates of 600, 1200, 2400, 4800, or 9600 bps. The card interfaces to a PSTN through an RJ11 jack. The modem can be controlled using industry-standard AT command software. A 40-character command line is provided for the AT command set, which is compatible with EIA document TR302.2/88-08006.

The modem automatically hangs up after a configured period of communications inactivity. Automated dial-up alarm reporting capabilities are possible. Refer to Spontaneous Report-by-Exception (SRBX).

LED indicators on the card show the status of the RXD, TXD, DTR, DSR, RI, and OH control lines. Refer to Figure 4-5 and Table 4-1. The modem card also provides EIA-232 (RS-232) level output signals for an analyzer. When activated as described in Section 4.5.5, Dial-Up Modem Communications Card Wiring, on page 4-19 these signals are available at the COMM port connector on the front panel.

Refer to Section 4.5.5, Dial-Up Modem Communications Card Wiring, on page 4-19

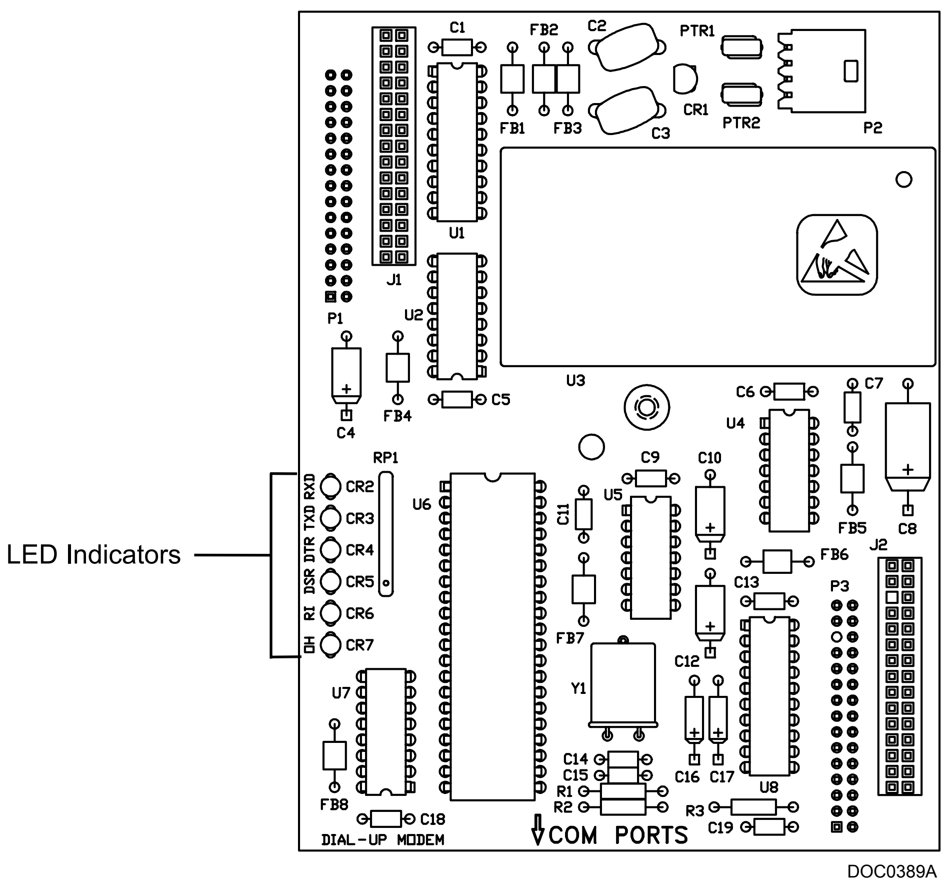


Figure 4-5. Dial-up Modem Communications Card

4.4 Initial Installation and Setup

The following procedure assumes **the first-time installation of a communications card in a FloBoss that is currently not in service.** For FloBoss units currently in service, refer to the procedures in Section 4.6, Troubleshooting and Repair, on page 4-20.

⚠ CAUTION

When installing units in a hazardous area, ensure that the components selected are labeled for use in such areas. Change components only in an area known to be non-hazardous. Performing these procedures in a hazardous area could result in personal injury or property damage.

⚠ CAUTION

Be sure to use proper electrostatic handling, such as wearing a grounded wrist strap, or components on the circuit cards may be damaged.

4.4.1 Installing Communications Cards

All communications cards install into the FloBoss 407 in the same manner. To install a communications card, proceed as follows:

1. Loosen the captive screw that holds the door in place, and open the door.
2. Install the communications card onto the processor board located on the door. Plug the card into its mating connectors (J1 and J2) on the processor board and gently press until the connectors firmly seat.
3. Install the retaining screw to secure the card. Orient the card with the COM PORTS arrow pointing down. Figure 4-6 shows the correct communications card orientation.
4. For communications cards with an external telephone jack, install the jack in the bracket mounted on the termination card at J1. Connect the jack cable to the board connector labeled P2. Figure 4-6 shows the jack location.
5. If you are installing a modem card, set the jumpers on the card in the proper position as described in Table 4-2 and set the output attenuation level as described in Table 4-3.
6. Close the door and fasten with the captive screw.
7. Refer to Section 4.5, Connecting Communication Cards to Wiring, on page 4-13.

❖ **NOTE:** If you are installing a Dial-up or Leased-Line Modem Card, it is recommended that you install a telephone-style surge protector between the RJ11 jack and the outside line.

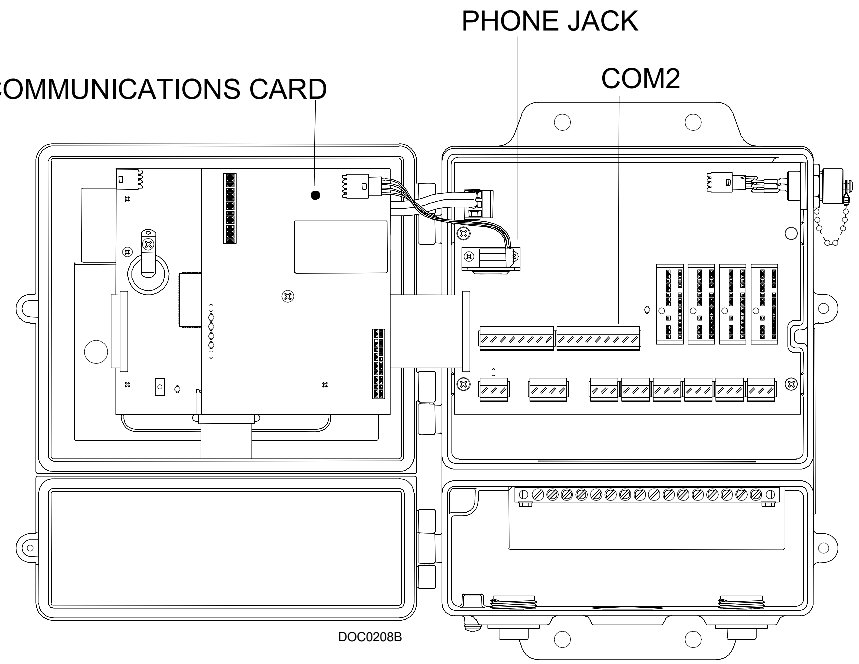


Figure 4-6. Communications Card Location

4.4.2 Setting Modem Card Jumpers

The Radio Modem and Leased-Line Modem Communications Cards make use of jumpers to select certain operational modes. It is essential that these jumpers be in their proper position for correct operation of the modem.

Table 4-2 shows the operating modes and the associated jumper positions for the cards.

The Leased-Line Modem card is set by default for 2-wire operation. To use it for 4-wire operation, jumpers P3, P4, and P5 must be placed in the positions indicated in Table 4-2.

The Radio Modem card uses jumper P6 to enable power control for keying up a radio. The jumper either grounds or isolates the push-to-talk (PTT) return line, which is used to key up a radio to transmit. Jumper P6 has a default setting of GND (ground), but it can be set to ISO (isolated) to achieve a floating PTT return, if the radio circuitry requires it.

Table 4-2. Jumper Positions for the Leased-Line and Radio Modem Cards

Mode	**Leased-Line Modem Jumpers**		
	P3	P4	P5
2-Wire (default)	2W	2W	2W
4-Wire	4W	4W	4W
Mode	**Radio Modem Jumper**		
	P6	–	–
PTT Grounded (default)	GND	–	–
PTT Isolated	ISO	–	–

4.4.3 Setting Modem Card Attenuation Levels

For the Radio Modem and Leased-Line Modem Communications Cards, the output level is set by default to 0 dB. This level can be reduced to better match the modem output to the line or radio. The adjustment is made by plugging a resistor into the card at the location labeled R2. Table 4-3 lists resistor values and the amount of attenuation they provide.

Table 4-3. Leased-Line and Radio Modem Card Attenuation Levels

Attenuation (dB)	R2 Value (Ohms)	Attenuation (dB)	R2 Value (Ohms)
–2	205 K	–12	15.8 K
–4	82.5 K	–14	11.5 K
–6	47.5 K	–16	8.66 K
–8	30.9 K	–18	6.65 K
–10	21.5 K	–20	5.11 K

Notes:
1. All resistor values are nominal; 1% ¼ W resistors are acceptable.
2. Attenuation resistors are typically not required for leased-line, private-line operation, or for a GE MCS radio.
3. Attenuation for a GE TMX radio is typically –20 dB.
4. Attenuation for an MDS radio is typically –10 dB.

4.5 Connecting Communication Cards to Wiring

Signal wiring connections to the communications cards are made through the COM2 terminal block located on the termination card and through TELCO connectors supplied with certain modem cards.

Table 4-4 shows the communications signal connection pin-outs for the COM1 port and the various communications cards available for the COM2 port on a FloBoss 407.

Table 4-4. FloBoss 407 Communications Signals

Comm Card Pin	1	2	3	4	5	6	7	8	9
COM1 Terminal Block									
Built-in EIA-232 (RS-232)	RXD	TX	RTS	CTS	DCD	DTR*	DSR	COM	
Communication Cards – COM2 Terminal Block									
EIA-232 (RS-232) Card	DCD	DSR	RX	RTS	TX	CTS	DTR	RI	COM
EIA-422/485 (RS-422/485) Card in RS-422 Mode		TX–	RX-		RX+	TX+			
EIA-422/485 (RS-422/485) Card in RS- 485 Mode			OUT-		OUT+				
RADIO MODEM				PTT+	RX	PTT-	TX		COM
LEASED-LINE MODEM, 4-wire Private Line	RX+	TX-	RX-					TX+	
DIAL-UP MODEM, (output only for analyzer)	SPK	RI	RX	SHUT DOWN	TX	+5V	DTR	DSR	COM
Communication Cards – RJ11 Port									
LEASED-LINE MODEM, RJ11 Port, 2-Wire			TIP (RED)	RING (GRN)					
LEASED-LINE MODEM, RJ11 Port, 4-Wire		TIP2 (BLK)	TIP1 (RED)	RING1 (GRN)	RING2 (YEL)				
DIAL-UP MODEM, RJ11 Port			RING (RED)	TIP (GRN)					
* Signal is permanently enabled (true).									

4.5.1 EIA-232 (RS-232) Communications Card Wiring

Figure 4-7 shows the relationship between the EIA-232 (RS-232) signals and terminal numbers for the COM2 terminal block.

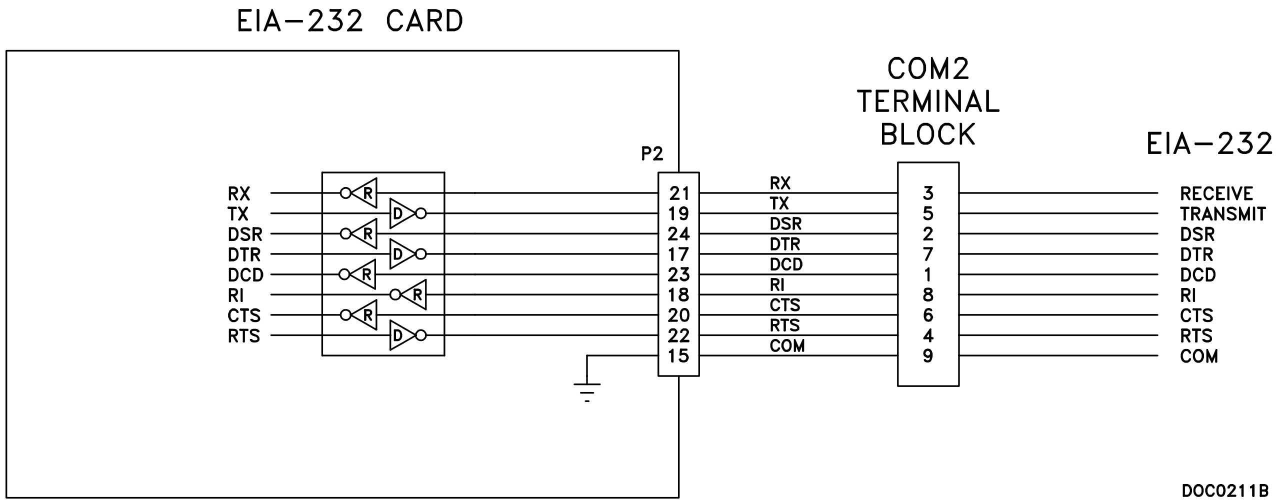


Figure 4-7. EIA-232 (RS-232) Wiring Schematic

4.5.2 EIA-422/485 (RS-422/485) Communications Card Wiring

Figure 4-8 shows the relationship between the EIA-422 (RS-422) signals and terminal numbers for the COM2 terminal block. EIA-422 (RS-422) wiring should be twisted pair cable, one pair for transmitting and one pair for receiving. Jumper P4 in the newer card (Jumper P3 in the older card) is used to control the RTS transmit function in the EIA-422 (RS-422) mode. This jumper has a default setting of RTS for multi-drop communications. Placing this jumper in the ON position enables the card to continuously transmit (point-to-point). This jumper has no effect when the card is wired for EIA-485 (RS-485) operation.

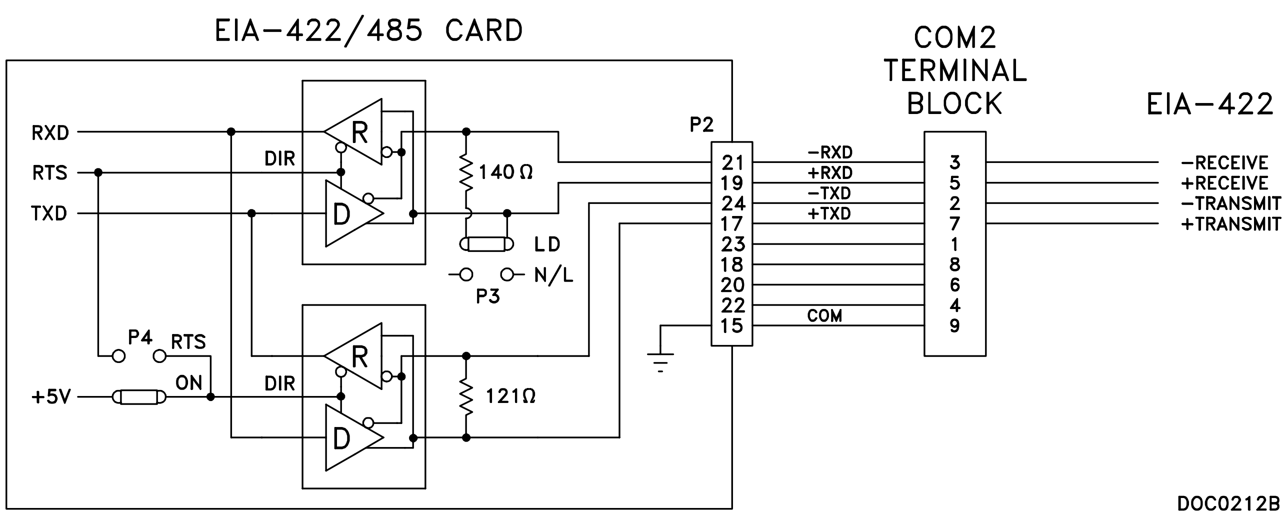


Figure 4-8. EIA-422 (RS-422) Wiring Schematic

Figure 4-9 shows the relationship between the EIA-485 (RS-485) signals and terminal numbers for the COM2 terminal block. Wiring should be twisted-pair cable. On newer design cards, Jumper P3 can be set to apply (LD) or remove (N/L) a 140-ohms load. Typically, the load would be used in a point-to-point application, and removed in multi-drop applications, except for one device on each end of the bus.

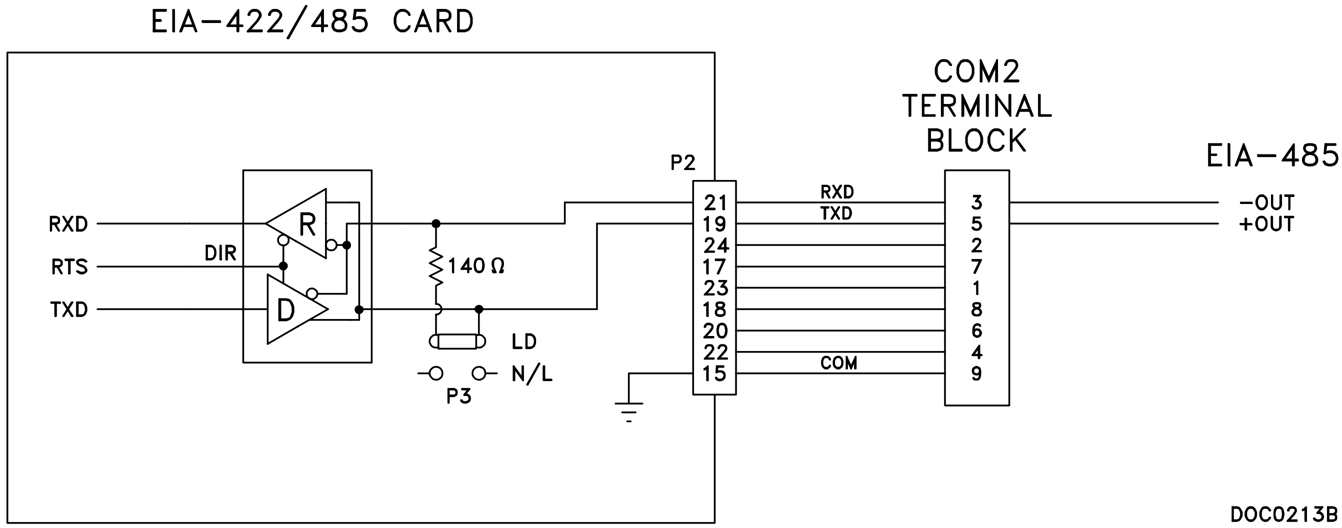


Figure 4-9. EIA-485 (RS-485) Wiring Schematic

4.5.3 Radio Modem Communications Card Wiring

The following signal lines are used with most radios:

COM2 Terminal	Signal Line	Description
4	PTT+	Push-to-talk switch
5	RXA	Receive data
6	PTT–	Push-to-talk return (may be grounded)
7	TXA	Transmit data
9	COM	FloBoss power supply ground

Jumper P6 determines whether the PTT signal is isolated or grounded. Use connector P7 signals for monitoring or connecting to an analyzer. Refer to Section 4.4.2, Setting Modem Card Jumpers, on page 4-11.

The output attenuation can be reduced to better match the modem output to the line or radio. Plugging a resistor into the card at R2 makes the adjustment. Refer to Section 4.4.3, Setting Modem Card Attenuation Levels, on page 4-12.

Figure 4-10 shows the relationship between the radio modem signals and terminal numbers for the COM2 terminal block.

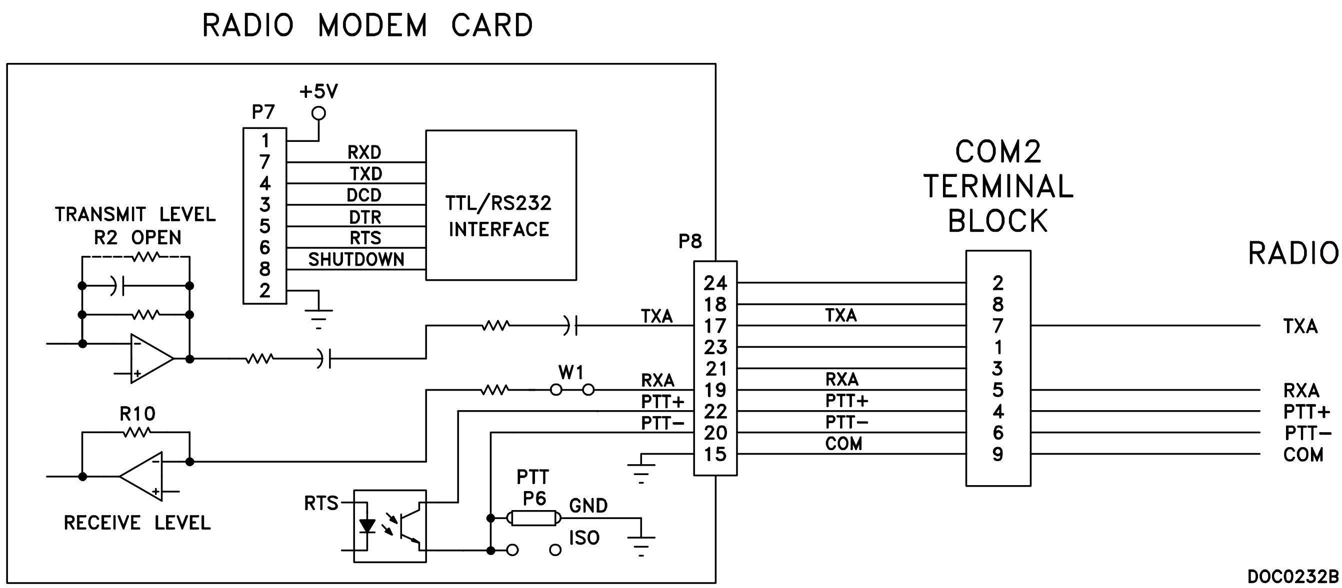


Figure 4-10. Radio Modem Wiring Schematic

The following signals, used for monitoring or connecting to an analyzer, are available at connector P7 located at the bottom edge of the card. These signals are normally not active. To activate them, pin 8 (Shutdown) must be grounded to pin 2 using a jumper; this does not affect normal operation. All unused signals can be left unterminated.

P7 Terminal	Function
1	+5 volts dc
2	COM
3	DCD
4	TXD
5	DTR
6	RTS
7	RXD
8	Shutdown

4.5.4 Leased-Line Communications Card Wiring

The Leased-line Modem Card interfaces to a leased line through the RJ11 jack. The terminal functions depend on the mode of operation of the card, either 2-wire or 4-wire, as follows:

RJ11 Terminal	Operating Mode	
	2-Wire	4-Wire
BLK	(Not used)	Tip2
RED	Ring	Ring1
GRN	Tip	Tip1
YEL	(Not used)	Ring2

❖ **NOTE:** On the Leased-Line Modem Card, Tip and Ring is shown reversed to comply with normal telephone signals and functions normally with the two signals reversed.

The Leased-Line Modem Communications Card has three jumpers (P3, P4, and P5) that permit either two-wire or four-wire operation. Use connector P7 signals for monitoring or connecting to an analyzer. Refer to Section 4.4.2, Setting Modem Card Jumpers, on page 4-11 for more information.

The output attenuation can be reduced to better match the modem output to the line or radio. Plugging a resistor into the card at R2 makes the adjustment. Refer to Section 4.4.3, Setting Modem Card Attenuation Levels, on page 4-12.

Figure 4-11 shows the wiring connections to the card.

❖ **NOTE:** If you are installing a Dial-up or Leased-Line Modem Card, it is recommended that you install a telephone-style surge protector between the RJ11 jack and the outside line.

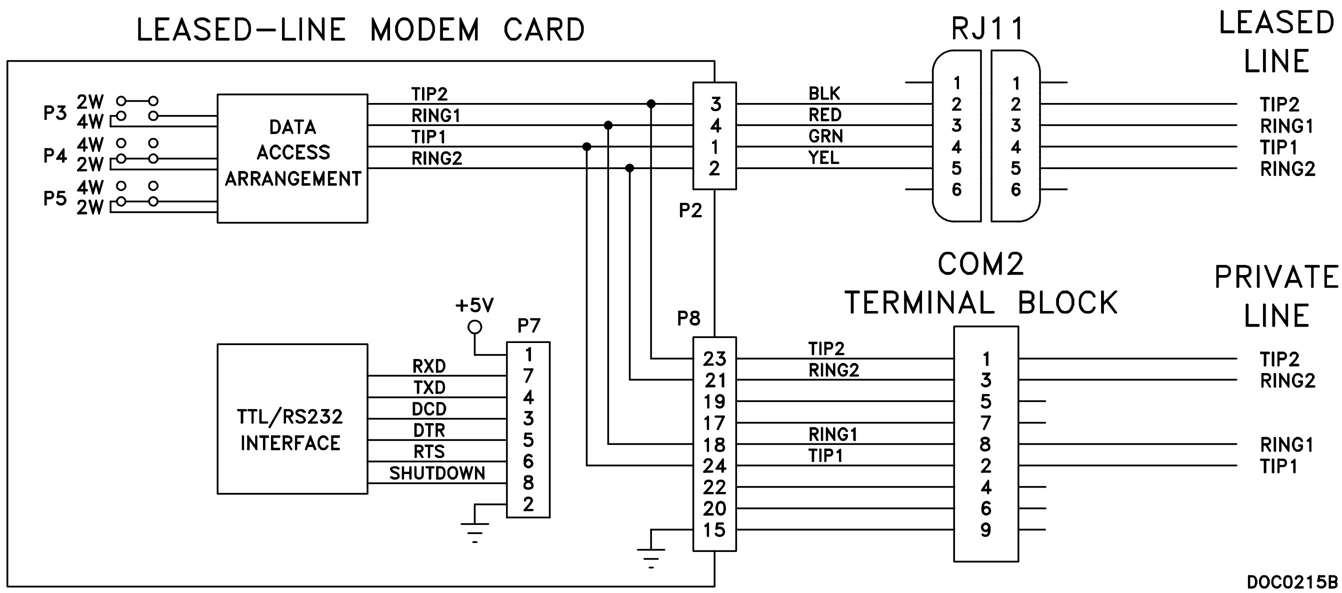


Figure 4-11. Leased-Line Modem Wiring Schematic

The 9-terminal COM2 terminal block mounted on the termination card can also be used to connect the modem to a private line. This connector is not FCC approved and cannot be used for leased-line operation. The terminal functions are:

COM2 Terminal	Operating Mode	
	2-Wire	4-Wire
1	–	Tip2
2	Tip	Tip1
3	–	Ring2
8	Ring	Ring1

The following signals, used for monitoring or connecting to an analyzer, are available at connector P7 located at the bottom edge of the card. These signals are normally not active. To activate them, pin 8

(Shutdown) must be grounded to pin 2 using a jumper. This does not affect normal operation. All unused signals can be left un-terminated.

P7 Terminal	Function
1	+5 volts dc
2	COM
3	DCD
4	TXD
5	DTR
6	RTS
7	RXD
8	Shutdown

4.5.5 Dial-Up Modem Communications Card Wiring

The Dial-Up Modem Card interfaces to a PSTN line through the RJ11 jack with two wires. The signals present at the RJ11 connector are:

RJ11 Terminal	Operating Mode (2-Wire)
GRN	Ring
RED	Tip

Figure 4-12 shows the relationship between the dial-up modem signals and pin numbers for the RJ11 connector and the COM2 connectors.

⚠ CAUTION

Care should be exercised to avoid shorting the +5 volts dc supply (terminal 6 on the COM2 terminal block) to common (terminal 9) or to any ground when wiring to COM2. Grounding terminal 6 causes the FloBoss to halt operation and data may be lost once a restart is initiated.

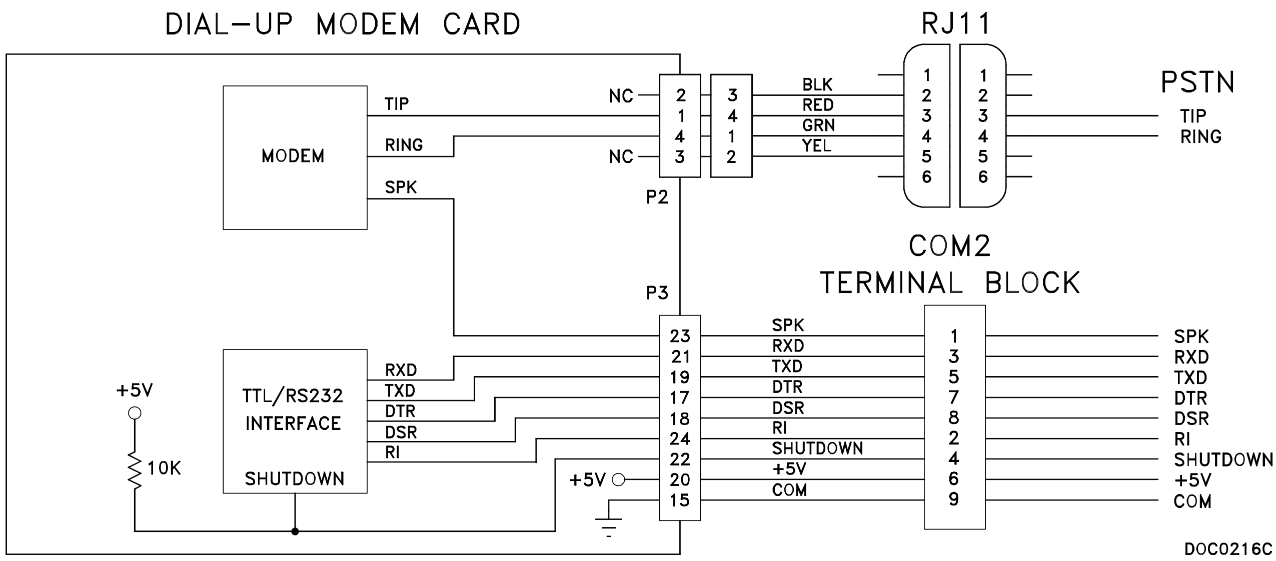


Figure 4-12. Dial-Up Modem Wiring Schematic

The following signals (output only) are available at the COM2 port for wiring to an analyzer or monitor. These signals are activated by shorting pin 4 (SHUTDOWN) to pin 9 (COM).

COM2 Terminal	Signal Line	Description
1	SPK	Speaker
2	RI	Ring indicator
3	RXD	Receive data
4	SHUTDOWN	Disable signal lines
5	TXD	Transmit data
6	+5V	5-volts dc power
7	DTR	Data terminal ready
8	DSR	Data set ready
9	COM	Common (Power Ground)

4.6 Troubleshooting and Repair

The communications cards have no user-serviceable parts. If a card appears to be operating improperly, verify that the card is set up according to the information contained in Section 4.4, Initial Installation and Setup, on page 4-10. If it still fails to operate properly, the recommended repair procedure is to remove and replace the card. The faulty card should be returned to your local sales representative for repair or replacement.

Follow the procedures below to help ensure data is not lost and equipment is not damaged during replacement of a communications card.

4.6.1 Replacing a Communications Card

If you are installing a communications card for the first time, refer to Section 4.4, Initial Installation and Setup, on page 4-10. To remove and replace a communications card on an in-service FloBoss 407, perform the following procedure. Be sure to observe the cautions to avoid losing data and damaging equipment.

⚠ CAUTION

When installing units in a hazardous area, ensure that the components selected are labeled for use in such areas. Change components only in an area known to be non-hazardous. Performing these procedures in a hazardous area could result in personal injury or property damage.

⚠ CAUTION

Be sure to use proper electrostatic handling, such as wearing a grounded wrist strap, or components on the circuit cards may be damaged.

⚠ CAUTION

During this procedure, all power will be removed from the FloBoss and devices powered by the FloBoss. Make sure that all connected input devices, output devices, and processes remain in a safe state, when power is removed from the FloBoss and when power is restored to the FloBoss. An unsafe state could result in property damage.

- ❖ **NOTE:** For a Measurement Canada FloBoss 407, resealing of the case must be performed by authorized personnel only.
- ❖ **NOTE:** There is a possibility of losing the FloBoss configuration and historical data held in RAM while performing the following procedure. As a precaution, save the current configuration and historical data to permanent memory. Refer to Section 2, Backup Procedure Before Removing Power.

1. To avoid losing data, perform backups as explained in Section 2, Backup Procedure Before Removing Power.
2. Disconnect power from the FloBoss.
3. Loosen the captive screw to open the top door.
4. If the communications card is a Dial-up or Leased-Line Modem Card, unplug the telephone jack cable from termination board connector P2.
5. Remove the retaining screw from the middle of the communications card. Using a rocking motion to disengage the connectors (J1 and J2), pull the card free from the processor board.
6. To reinstall a communications card, orient the card with the COM PORTS arrow pointing down. Plug the card into its mating connectors and gently press until the connectors firmly seat. Install the retaining screw to secure the card.
7. For a Dial-up or Leased-Line Modem Card, connect the phone jack cable to card connector P2.
8. If you are installing a replacement modem card, be sure to set the jumpers on the card in the proper position (Section 4.4.2, Setting Modem Card Jumpers, on page 4-11) and to set the output attenuation level (Section 4.4.3, Setting Modem Card Attenuation Levels, on page 4-12).
9. Close the door and fasten the captive retaining screw.

10. Reconnect power to the FloBoss by plugging in the power terminal connector.
11. Using ROCLINK configuration software, check the configuration data including ROC Displays and FSTs, and load or modify them as required.
12. Load and start any user programs as needed.
13. Verify that the FloBoss performs as required.
14. If you changed the configuration, save the current configuration data to memory by selecting ROC > Flags > Write to EEPROM or Flash Memory Save Configuration as instructed in the applicable ROCLINK configuration software or ROCLINK configuration software 800 configuration software user manual.
15. If you changed the configuration including the history database, ROC Displays, or FSTs, save them to disk.

4.7 Communications Card Specifications

The following tables list the specifications for each type of communications card.

Serial Communication Cards Specifications	
EIA-232D (RS-232) CARD Meets EIA-232 (RS-232) standard for single-ended data transmission over distances of up to 15 m (50 ft). **Data Rate:** Selectable from 300 to 9600 baud, depending on the configuration software used. **Format:** Asynchronous, 7 or 8-bit (software selectable) with full handshaking. **Parity:** None, odd, or even (software selectable). **EIA-422/485 (RS-422/485) CARD** Meets EIA-422 (RS-422) and EIA-485 (RS-485) standard for differential data transmission over distances of up to 1220 m (4000 ft). As many as ten devices can be connected on an EIA-422 (RS-422) bus. As many as 32 devices can be connected on an EIA-485 (RS-485) bus. **Data Rate:** Selectable from 300 to 9600 bps. **Format:** Asynchronous, 7 or 8-bit (software selectable). **Parity:** None, odd, or even (software selectable). **Termination Load:** 140 Ω, jumper selectable.	**LED INDICATORS** Individual LEDs for RXD, TXD, DTR, DCD, CTS, and RTS signals. Not all apply to EIA-422/485 (RS-422/485) communications. **POWER REQUIREMENTS** 4.75 to 5.25 V dc, 0.15 W maximum (supplied by FloBoss). **ENVIRONMENTAL** Same as the FloBoss in which the card is installed. Refer to the FloBoss specifications. **DIMENSIONS** 25 mm H by 103 mm W by 135 mm L (1 in. H by 4.05 in. W by 5.3 in. L). **WEIGHT** 80 g (3 oz) nominal. **APPROVALS** Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

Radio Modem Specifications

OPERATION

Mode: Full or half-duplex, direct connection to radio.

Data Rate: Up to 1200 baud asynchronous (software selectable).

Parity: None, odd, or even (software selectable).

Format: Asynchronous, 7 or 8 bit (software selectable).

Modulation: Phase coherent, Frequency Shift Keyed (FSK).

Carrier Frequencies: Mark 1200 Hz ± 0.1%; Space 2200 Hz ± 0.1%.

Input Impedance: 20 kΩ, unbalanced.

Output Impedance: 600 Ω balanced.

RTS-to-Transmission Delay: Configurable in 10 ms increments.

Sensitivity: –35 dBm.

PTT Signal: Isolated, solid-state switch.

LED Indicators: TXD, RXD, DTR, DCD, CTS, and RTS.

POWER REQUIREMENTS

4.75 to 5.25 V dc, 0.11 W typical (supplied by FloBoss).

ENVIRONMENTAL

Operating Temperature: –40 to 75ºC (–40 to 167ºF).

Storage Temperature: –50 to 85ºC (–58 to 185ºF).

Operating Humidity: To 95% relative, non-condensing.

DIMENSIONS

25 mm H by 103 W mm by 135 mm L (1 in. H by 4.05 in. W by 5.3 in. L).

WEIGHT

100 g (3.6 oz) typical.

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

Leased-Line Modem Specifications

OPERATION

Mode: Full or half-duplex on 2-wire or 4-wire private channel (compatible with Bell 202T).

Data Rate: Up to 1200 baud asynchronous (software selectable).

Parity: None, odd, or even (software selectable).

Format: Asynchronous, 7 or 8 bit (software selectable).

Modulation: Phase coherent, Frequency Shift Keyed (FSK).

Carrier Frequencies: Mark 1200 Hz ± 0.1%; Space 2200 Hz ± 0.1%.

Input Impedance: 600 Ω balanced transformer input.

Output Impedance: 600 Ω balanced transformer output.

RTS-to-Transmission Delay: Configurable in 10 ms increments.

Sensitivity: –35 dBm.

Maximum Output Level: 0 dBm nominal into 600 Ω.

LED Indicators: TXD, RXD, DTR, DCD, CTS, and RTS.

Surge Protection: Conforms to FCC part 68.

OPERATION (CONTINUED)

Certification: FCC Part 68 tested.

Connector: RJ11 type.

POWER REQUIREMENTS

4.75 to 5.25 V dc, 0.11 W typical (supplied by FloBoss).

ENVIRONMENTAL

Operating Temperature: –40 to 75ºC (–40 to 167ºF).

Storage Temperature: –50 to 85ºC (–58 to 185ºF).

Operating Humidity: To 95% relative, non-condensing.

DIMENSIONS

25 mm H by 103 mm W by 135 mm L (1 in. H by 4.05 in. W by 5.3 in. L).

WEIGHT

135 g (4.7 oz) typical.

APPROVALS

Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

Dial-Up Modem Specifications	
OPERATION **Mode:** Full-duplex 2-wire for dial-up PSTN (Bell 212 compatible). **Data Rate:** Up to 14.4K bps asynchronous (software selectable). **Parity:** None, odd, or even (software selectable). **Format:** 8, 9, 10, or 11 bits, including start, stop, and parity (software selectable). **Modulation:** V.32 and V.32 bis, V.21 and 103, binary phase-coherent FSK, V.22 and 212A, and V.22 bis. **Transmit Amplitude:** –1 dB typical. **Telephone Line Impedance:** 600 Ω typical. **RTS-to-Transmission Delay:** Configurable in 10 ms increments. **Receiver Sensitivity:** Off-to-On threshold: –45 dBm. On-to-Off threshold: –48 dBm. **Maximum Output Level:** 0 dBm nominal into 600 Ω. **LED Indicators:** TXD, RXD, DTR, DSR, RI, and OH. **Surge Protection:** Conforms to FCC part 68 and DOC. **Surge Isolation:** 1000 V ac and 1500 V peak. **Certification:** FCC Part 68 approved. **Connector:** RJ11 type.	**POWER REQUIREMENTS** 4.5 to 5.5 V dc, 0.4 W maximum (supplied by FloBoss). **ENVIRONMENTAL** **Operating Temperature:** –40 to 75ºC (–40 to 167ºF). **Storage Temperature:** –50 to 85ºC (–58 to 185ºF). **Operating Humidity:** To 95% relative, non-condensing. **DIMENSIONS** 25 mm H by 103 mm W by 135 mm L (1 in. H by 4.05 in. W by 5.3 in. L). **WEIGHT** 130 g (4.6 oz) typical. **FCC INFORMATION** **Registration Number:** DWE-25983-M5-E. **Ringer Equivalent:** 1.0B **APPROVALS** Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

SECTION 5 – DISPLAY AND KEYPAD

5.1 Scope

This section describes the FloBoss 407 display that includes Liquid Crystal Display (LCD) and Keypad. The LCD and Keypad allows you to access data and configuration parameters in the FloBoss 407 Flow Manager. Topics covered in this section include:

5.2 Product Description

The display is a 2-line by 20-character Liquid Crystal Display (LCD) visible through the FloBoss 407 enclosure cover. Refer to Figure 5-1. The temperature-compensated display, mounted on the processor board, allows you to view point configuration parameters and related point data values on-site without requiring an additional device, such as a PC.

Figure 5-1. FloBoss 407 Display and Keypad

A membrane Keypad (Figure 5-2) with three rows of five keys allows you to interface with the flow computer and activate the various displays configured for the local system. The Keypad provides you with on-site parameter editing and monitoring capabilities. The Keypad is mounted in the main door of the flow computer enclosure and has a gasket cover to protect it from the elements when not in use. The Keypad communicates with the FloBoss and receives its power through the Keypad connector located on the processor board.

Each key on the Keypad can be used in three different modes, as indicated by the label color: Normal operations (black label), Edit operations (red label), and Alternate operations (white label below key).

To perform a **Normal** operation, press the desired key (neither EDIT or ALT keys are used). To perform an **Edit** operation (to key in a value), press the EDIT key and then the desired key or keys. Press the ENTER key when you are done keying in the value. Each time you want to perform an **Alternate** operation, press the ALT key and then the desired key.

❖ **NOTE:** To make sure that the key you press activates, push firmly in the center of the key.

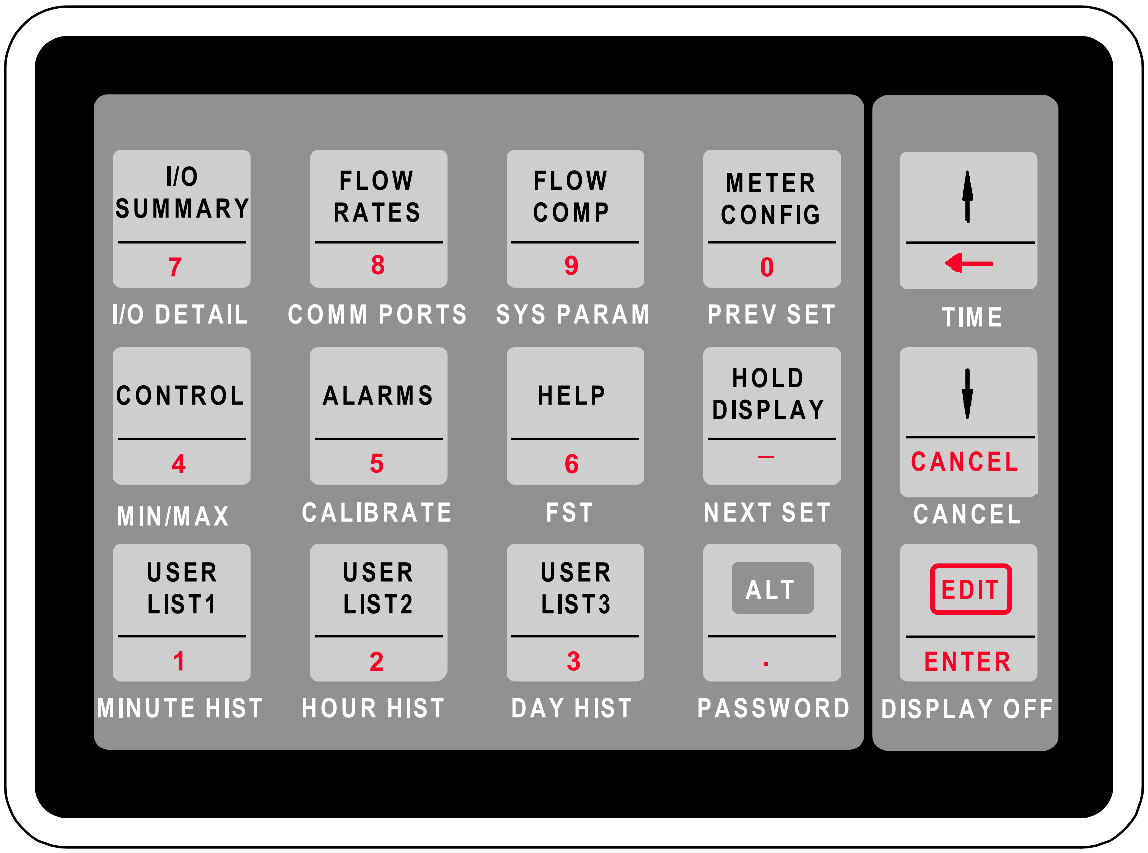


Figure 5-2. Keypad Layout

Figure 5-2 provides a brief description of the Keypad functions and the expected displays.

To activate the display, press any key, for example I/O SUMMARY. This returns a password prompt to the display. Enter the numeric password with the Keypad and press ENTER. A date and time message shows on the LCD. Refer to Section 5.5, Security, on page 5-14 concerning password security.

Select one of the categories to view from the Keypad. The information scrolls on the LCD. Press HOLD DISPLAY to stop the list from scrolling on the LCD. The FloBoss 407 continuously updates the current display until the HOLD DISPLAY key is pressed to return the list to the scroll mode.

Table 5-1. FloBoss 407 Keypad Functions

Function	Key	Display
Log On	Press Any Key	Password prompt
Parameter Lists	Enter Password	Date and time
	I/O SUMMARY	Tag, value, and alarm for each I/O point
	ALT + I/O DETAIL	Parameters for selected I/O point
	FLOW RATES	Flow parameters for selected meter run
	ALT + COMM PORTS	Parameters for selected communications port
	FLOW COMP	Gas composition for selected meter run
	ALT + SYS PARAM	System parameters: address, contract hour, and such.
	METER CONFIG	Meter configuration for selected meter run
	ALT + TIME	Date and time
	CONTROL	Proportional, Integral, and Derivative (PID) loop Parameters
	ALT + FST	Function Sequence Table (FST) Parameters
	USER LIST 1,2,3	User defined parameter list 1, 2, or 3
	ALT + CALIBRATE	Calibration procedure
	ALARMS	Alarm Log
History Functions	ALT + MIN/MAX	Minimum and Maximum History Log
	ALT + MINUTE HIST	Minute History Log
	ALT + HOURS HIST	Hours History Log
	ALT + DAY HIST	Day History Log
Display Control	UP or DOWN	Manually scrolls parameter list
	ALT + PREV/NEXT SET	Selects previous or next set of parameters
	HOLD DISPLAY	Stops scroll or updates value or press again to resume
Keypad Control	EDIT	Allows edit of current parameter or enter to save
	BACKSPACE	Edit mode backspace erase
	CANCEL	Stops edit mode or resumes list display
	ALT + CANCEL	Cancels the operation in progress
Quit	ALT + PASSWORD	Logs out current user or displays password prompt
	ALT + DISPLAY OFF	Logs out current user or shuts the display off

The DOWN ARROW key displays the next parameter in the list or changes the display to the next point. The UP ARROW key displays the previous parameter in the list or changes the display to the previous point.

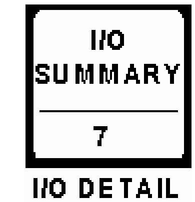
The ALT key activates the key functions labeled below each key. For example, pressing ALT and the “7” key would activate the I/O DETAIL function which would display the entire set of parameters for the selected I/O point. ALT and ENTER activates the DISPLAY OFF function and turns off the LCD. Press any key to reactivate the LCD.

The EDIT key activates the functions labeled in red on each key. This includes the numeric digits, the “–”, the “.”, and the backspace (←) key. The backspace key is an edit-only function. Those parameters that allow editing can be changed if the edit mode is selected. The CANCEL key stops the edit mode and resumes list display.

5.3 Keypad Functions

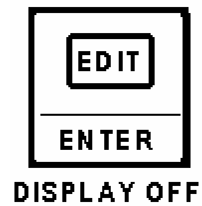
Table 5-2 defines the function associated with each of the Keypad labels.

5.3.1 Normal Mode



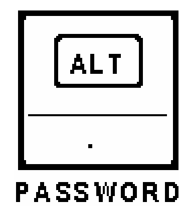
The Keypad functions shown in the Normal Mode column of Table 5-2 operate when the key, such as I/O Summary, is independently pressed. Refer to Figure 5-3.

5.3.2 Edit Mode



The functionality listed in the Edit Mode column of Table 5-2 occurs when the EDIT key is first pushed. This mode continues until the CANCEL or ENTER key is pressed. The ENTER key typically saves the edit to memory. Refer to Figure 5-3.

5.3.3 Alt Mode



The functions listed in the Alt Mode column of Table 5-2 are activated by pressing and releasing the ALT key. Then press the desired key. The ALT key must be pressed each time to activate the ALT mode. Refer to Figure 5-3.

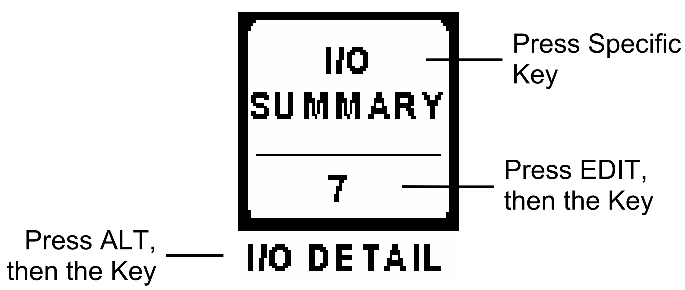


Figure 5-3. Operations Key

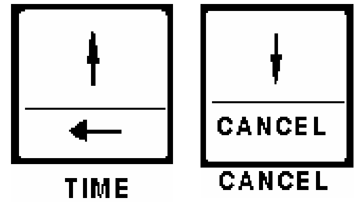
Table 5-2. Definition of the Keypad Functions

KEY	NORMAL MODE	EDIT MODE	ALT MODE
I/O SUMMARY	Displays the following for each **I/O point**: Tag Current Value Alarm Code	Displays Digit ‘**7**’ on LCD for data entry.	**I/O DETAIL** Displays the entire set of parameters for the I/O point selected.
FLOW RATES	Displays the following for a selected **meter run**: MCF Today MCF Yesterday MCF/Day (Current Flow Rate) MMBTU/Day (Current BTU Rate) Meter Input Static Pressure Temperature	Displays digit ‘**8**’ on LCD for data entry.	**COMM PORTS** Displays the following for selected communication port: Baud Rate Stop Bits Data Bits Parity Status Mode Key-on Delay Key-off Delay Retry Count Retry Time Alarm Pointer Recv Counter Copy Retry Counter Valid Receive Ctr

KEY	NORMAL MODE	EDIT MODE	ALT MODE
FLOW COMP	Displays the following **gas composition parameters** for a selected meter run: Specific Gravity Heating Value Viscosity Specific Heat Ratio Base Pressure Base Temperature N_2 – Nitrogen % CO_2 – Carbon Dioxide % H_2S – Hydrogen Sulfide % H_2O – Water % He – Helium % CH_4 – Methane % C_2H_6 – Ethane % C_3H_8 – Propane % C_4H_{10} – n-Butane % C_4H_{10} – i-Butane % C_5H_{12} – n-Pentane % C_5H_{12} – i-Pentane % C_6H_{14} – n-Hexane % C_7H_{16}– n-Heptane % C_8H_{18} – n-Octane C_9H_{20} – n-Nonane $C_{10}H_{22}$ – n-Decane % O_2 – Oxygen % CO – Carbon Monoxide % H_2 – Hydrogen %	Displays digit ‘**9**’ on LCD for data entry.	**SYS PARAM** The following system parameters display: Part Number ROC Address ROC Group Station Name Contract Hour
METER CONFIG	Displays the following for selected **meter run**: Pipe Diameter Orifice Diameter Latitude Elevation Calculation Method AGA Configuration Orifice Material Low Flow Cutoff	Displays digit ‘**0**’ on LCD for data entry.	**PREV SET** Displays the previous set of parameters, if applicable.
↑	Displays the **previous parameter** in the list or changes the display to the previous point.	Backspace ‘←’ on LCD for data entry.	**TIME** Displays the following: Current Date Current Time

KEY	NORMAL MODE	EDIT MODE	ALT MODE
CONTROL	Displays the following for a selected **PID loop**: Control Type (8 bits) Switch Status Actual Scan Time Pri Setpoint Pri Process Variable Pri Output EU Pri Proportional Gain Pri Integral Gain Pri Derivative Gain Pri Loop Period Pri Setpoint EU/Min Pri Integral Deadband Pri Scale Factor	Displays digit '**4**' on LCD for data entry.	**MIN/MAX** Displays Min/Max history.
ALARMS	**Alarm Log**.	Displays digit '**5**' on LCD for data entry.	**CALIBRATE** Calibration procedure for the MVS.
HELP	A key selection, followed by Help, returns a **description of the functionality** of the key that was selected.	Displays digit '**6**' on LCD for data entry.	**FST** FST execution status and register values display for the four FSTs.
HOLD DISPLAY	The **LCD shows and updates the current display** until the HOLD DISPLAY key is pressed again.	Displays minus sign'**–**' on LCD for data entry.	**NEXT SET** Displays the next set of parameters, if applicable.
↓	Displays **the next parameter** in the list or changes the display to the next point.	**CANCEL** Stops Edit Mode and resumes list display.	**CANCEL** Cancels the operation in progress.
USER LIST 1	Displays parameters in user defined **list number 1**.	Displays digit '**1**' on LCD for data entry.	**MINUTE HIST** Displays Minute History Log.
USER LIST 2	Displays parameters in user defined **list number 2**.	Displays digit '**2**' on LCD for data entry.	**HOUR HIST** Displays Hour History Log.
USER LIST 3	Displays parameters in user defined **list number 3**.	Displays digit '**3**' on LCD for data entry.	**DAY HIST** Displays Day History Log.
ALT	**Activates Alternate mode** - the functions labeled in white below each key. For example, on the I/O SUMMARY key, I/O DETAIL activates.	Displays decimal point '**.**' on LCD for data entry.	**PASSWORD** Logs current user off and prompts for new password.
EDIT	**Activates Edit mode** - the functions labeled in red on each key. This includes the numeric digits, the "–", the ".", and the backspace (←) key. The CANCEL key stops Edit mode.	**ENTER** Validates and saves an edit, or selects a menu item, such as during calibration.	**DISPLAY OFF** Logs current user off and turns off the LCD. Press any key to activate the password display.

5.3.4 Arrow Keys



The ↑ and ↓ keys are used to scroll through the lists when the Hold Display mode is invoked. To skip a whole group of parameters, select NEXT SET. For example, the FLOW RATES key normally displays the parameters for the first meter run. The ↑ and ↓ keys scroll through the parameters for the first meter run. To move to the second meter run, press ALT and NEXT SET. The LCD starts displaying the parameters for the second meter run. The arrow keys similarly allows quick access to parameters for control loops, and I/O points.

5.4 Display of Parameters

The LCD displays various functions when selected from the Keypad. The display consists of a 2-line by 20-character LCD display. The list of parameters displayed is selected by pressing a key such as I/O SUMMARY. After pressing the key, a predefined list of parameters starts displaying one after another with a three second pause between parameters.

Figure 5-4 shows the format of all displays except for those selected with the ALARMS key, USER LIST keys, MIN/MAX key, the MINUTE HIST, HOUR HIST, and DAY HIST keys, and the CALIBRATE key. Refer to the *ROC/FloBoss Accessories Instruction Manual* (Form A4637) for details on the CALIBRATE key displays. The other displays that vary from the format shown in Figure 5-4 are next.

P	O	I	N	T	_	T	A	G	_			1	2	3	4	.	5	0	
D	E	S	C	R	I	P	T	I	O	N									

Figure 5-4. General Display Format

On the general display, the **point tag** displays in the first ten characters of the top line of the display and the **value** of the parameter displays on the remainder of the top line. The bottom line has an associated **descriptor**. To advance to another point, press the ALT key and then NEXT SET. The Normal and ALT Mode columns in Table 5-2 lists the parameters normally displayed when a function is selected with the Keypad.

5.4.1 I/O Summary

Press the **I/O SUMMARY** key to display a list of all configured I/O points.

Table 5-3 lists the value type (parameter) shown on the I/O Summary display for the various point types used by the FloBoss 407.

Table 5-3. Value Shown on Display

Point Type	Value
AI	Engineering Units
AO	Engineering Units
PI	Engineering Units
DI (TDI)	Engineering Units
DI (Not TDI)	Status
DO (TDO)	Engineering Units
DO (Not TDO)	Status
MVS	Differential Pressure Static Pressure Temperature

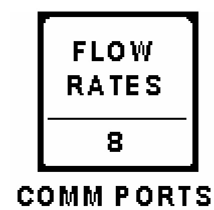
5.4.2 I/O Detail

I/O Detail displays the entire set of parameters for the currently selected I/O point. To use I/O Detail:

1. Press **I/O SUMMARY**.
2. Press **EDIT** to select a parameter from the I/O point list.
3. Press **ALT** and **I/O DETAIL**.

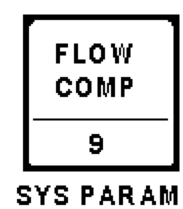
The values for the selected parameter display.

5.4.3 Flow Rates



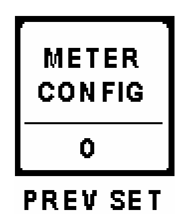
Press the **FLOW RATES** key to display the flow rate parameters for the first meter run. The $\uparrow$ and $\downarrow$ keys scroll through the parameters for the first meter run. To move to the second meter run, press **ALT** and **NEXT SET**. The LCD starts displaying the parameters for the second meter run.

5.4.4 Flow Comp



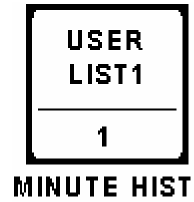
Press the **FLOW COMP** key to display the gas composition parameters for the first meter run. The $\uparrow$ and $\downarrow$ keys scroll through the parameters for the first meter run. To move to the second meter run, press **ALT** and **NEXT SET**. The LCD starts displaying the parameters for the second meter run.

5.4.5 Meter Config



Press the **METER CONFIG** key to display information concerning the selected meter run. The LCD displays the pipe diameter, orifice diameter, latitude, elevation, calculation method, tap type, orifice material, and DP low flow cutoff for the meter run.

5.4.6 User List Keys



The three USER LIST keys are **USER LIST1**, **USER LIST2**, and **USER LIST3**. The USER LIST keys display lists of parameters configured using ROCLINK for Windows or ROCLINK 800 Configuration Software. Figure 5-5 shows the format of the User List display.

```
LIST #1     1 OF 10
DESCRIPTION  VALUE
```

Figure 5-5. User List Display

5.4.7 Alarms

The **ALARMS** key causes the FloBoss 407 to scroll through the Alarm Log. The display shows the date of the logged alarm as month, day and the time as hour : minute (12:06).

The **SET/CLR** field indicates whether the alarm is set or cleared. The **TYPE** field displays a 4-character alarm type description, such as (LOLO, HIHI). The **TAG** and **VALUE** fields identify the tag of the point alarmed and the value at the time of alarm.

Figure 5-6 shows the alarm summary display.

```
DATETIMESET/CLR TYPE
TAG     VALUE
```

Figure 5-6. Alarm Summary Display

5.4.8 Min/Max History

Figure 5-7 through Figure 5-11 show examples of history displays on the FloBoss. Press the **ALT** key and press the **MIN/MAX** key. Figure 5-7 shows the general format for the Min/Max History List display.

```
MIN/MAX History TYPE
I/O TAG    PARAMETER
```

Figure 5-7. Min/Max History List Format

A list of configured history points begins scrolling when the ALT key and MIN/MAX is pressed. Figure 5-8 shows a list display for the board temperature point which can be selected with the **ENTER** key.

```
MIN/MAX History  Avg
Brd Temp    Filtered
```

Figure 5-8. Min/Max History List Example

Figure 5-9, Figure 5-10, and Figure 5-12 show the minimum (Min) reading, maximum (Max) reading, and the current (Cur) reading displays for a selected point. The time in the current contract day that the minimum and maximum events occurred is shown as hour : minute.

```
Brd Temp    Filtered
MIN   88.5840  09:57
```

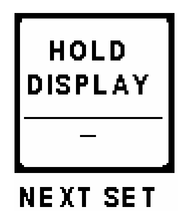
Figure 5-9. Min/Max History Minimum Value Example

```
Brd Temp    Filtered
MAX   98.4420  16:54
```

Figure 5-10. Min/Max History Maximum Value Example

```
Brd Temp    Filtered
CUR   98.4420
```

Figure 5-11. Min/Max History Current Value Example



To review values of other configured MIN/MAX points, press **ALT** and **NEXT SET**. The values for the next configured Min/Max point display.

To return to the Min/Max history list, press **ALT** and then **MIN/MAX**.

5.4.9 Minute History

Figure 5-12 shows the general format for the Minute History List display.

```
MINUTE History  TYPE
I/O TAG    PARAMETER
```

Figure 5-12. Minute History List Format

The minute history configured points list scrolls when the **ALT** key and **MINUTE HIST** key is pressed. Figure 5-13 shows a list display for the PID #1 point which can be selected from the scrolling list by pressing the ENTER key.

```
MINUTE History  Cur
PID  #1       PRI PV
```

Figure 5-13. Minute History List Example

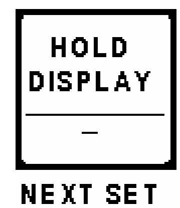


Figure 5-14 shows an example of a Minute History List display. The minute history scrolls, displaying the minute values every three seconds. By pressing the **HOLD DISPLAY** key, the minute history stops scrolling, and the arrows key can be used to increment the minute values.

```
PID  #1       PRI PV
MIN #45     36.5937
```

Figure 5-14. Minute History Value Example

5.4.10 Hour History

Figure 5-15 shows the general format for the Hour History List display.

```
HOUR   History  TYPE
I/O TAG    PARAMETER
```

Figure 5-15. Hour History List Format

The hour history configured points list scrolls when the **ALT** key and **HOUR HIST** key is pressed. Figure 5-16 shows a list display for the MVS #1 point, which can be selected with the ENTER key from the scrolling list.

```
HOUR   History  Acc
MVS  #1   DP Reading
```

Figure 5-16. Hour History List Example

Figure 5-17 shows an example of a Hour History List display. The hour history scrolls, displaying the hour values every three seconds. When the HOLD DISPLAY key is pressed, the hour history stops scrolling and the arrow keys can be used to increment the hours. The date is shown as month-day, followed by the hour.

```
MVS  #1    DP Reading
05-09,16      36.5937
```

Figure 5-17. Hour History Value Example

5.4.11 Day History

Figure 5-18 shows the general format for the Day History List display.

```
DAY     History   TYPE
I/O TAG     PARAMETER
```

Figure 5-18. Day History List Format

The day history configured points list scrolls when the **ALT** key and then **DAY HIST** key is pressed. Figure 5-19 shows a list display for the MVS #1 point, which can then be selected with the ENTER key.

```
DAY     History   Tot
MVS  #1     Press Rea
```

Figure 5-19. Day History List Example

The example shown in Figure 5-20 is a Day History value display. The date is shown as month-day, and the time shows the configured beginning hour of the contract day.

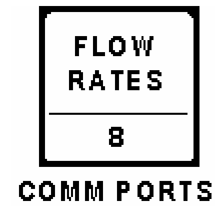
```
MVS  #1     Press Rea
04-23,14     13.6626
```

Figure 5-20. Day History Value Example

5.4.12 Control

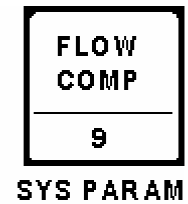
Press the **CONTROL** key to display the following information concerning the currently selected PID loop: Control Type, Switch Status, Actual Scan Time, Pri Setpoint, Pri Process Variable, Pri Output, Pri Proportional Gain, Pri Integral Gain, Pri Derivative Gain, Pri Loop Period, Pri Setpoint EU/Min, Pri Integral Deadband, and Pri Scale Factor.

5.4.13 Comm Ports



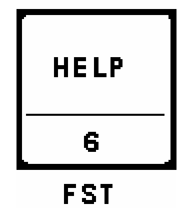
Press the **ALT** key and **COMM PORTS** to display information concerning the currently selected communications port. The LCD displays the communications Port Baud Rate, Stop Bits, Data Bits, Parity, Status, Mode, Key-On Delay, Key-Off Delay, Retry Count, and Retry Time.

5.4.14 Sys Param



Press the **ALT** key and **SYS PARAM** to display information concerning system parameters. The following system parameters display: Part Number, Address, Group, Station Name, and Contract Hour.

5.4.15 Help

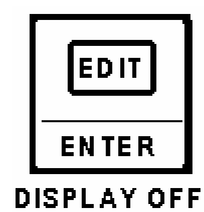


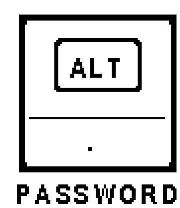
Press the **HELP** key to display help information concerning the currently select option.

5.5 Security

Security features are implemented through User Lists in ROCLINK configuration software. Each user is assigned a 4-digit password. Refer to the *ROCLINK for Windows Configuration Software User Manual* (Form A6091) or the *ROCLINK 800 Configuration Software User Manual* (Form A6121).

5.5.1 Logging Off the LCD

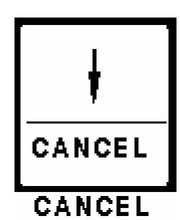




The LCD continues to display the last selected list or value until it is turned off. To turn the display off and log off, press the **ALT** and **DISPLAY OFF** key. To restart the Keypad operations, press any key and enter your Password.

Another way to secure the display is to press the **ALT** key and **PASSWORD**. This logs the current user out of the system. To reactivate
Keypad operations, you must log on with a correct password.

5.5.2 Continually Displaying the Last Parameter



After logging out using ALT and PASSWORD, press the **ALT** key and the **CANCEL** key to cause the LCD to show the last parameter displayed.

For example, if at a particular FloBoss 407 installation you wanted to continually monitor a Min/Max reading:

1. Press any **key**.
2. Enter your **Password**.
3. Press the **ALT** key and **MIN/MAX**.

4. Select the desired history point to display its values.
5. Log off with **ALT** and **PASSWORD**.
6. Press **ALT** and **CANCEL**.

The previously selected values continually displays until someone logs on.

5.6 Troubleshooting and Repair

The processor board must be removed to replace the Keypad and Display. See Section 2, Master Controller Unit, I/O Module Rack, and Wiring, for the processor board, Keypad, and Display removal procedures.

APPENDIX A – LIGHTNING PROTECTION MODULE

This appendix describes the optional Lightning Protection Module (LPM). Topics covered include:

A.1 Product Description

Figure A-1 shows a front and side view of the module. The LPM is designed to prevent damage to I/O modules and to built-in I/O circuitry from any high-voltage transients that may occur in field wiring. The LPMs plug into the field wiring I/O termination sockets located on the termination card.

The LPM provides screw terminals for connecting to field wiring. It has sockets for plugging in a range resistor, especially when used with built-in I/O. The module also provides a ground wire for connection to the enclosure ground bar.

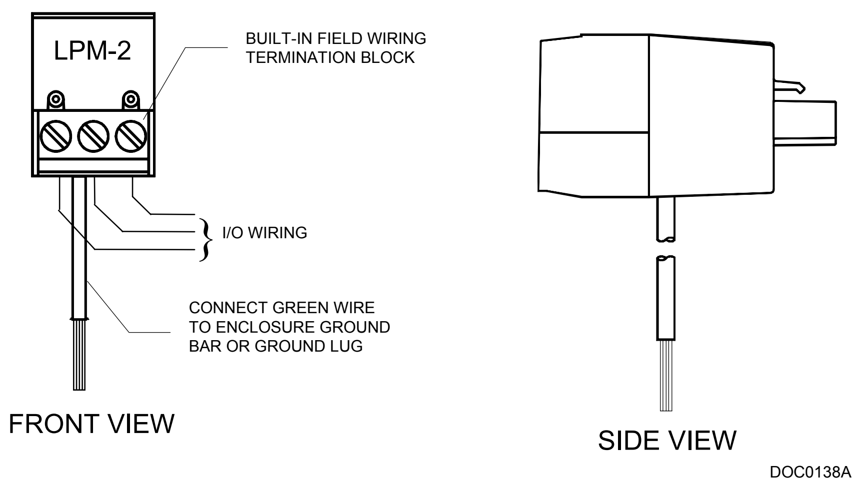


Figure A-1. Lightning Protection Module

In general, it is recommended an LPM be used to protect the circuitry for each field input or output. An LPM can be used with any type of input or output as long as the normal operating range of the input or output is less than the clamping release voltage of the LPM; therefore, the LPM **cannot be used with a 120 volts ac signal on a DO Relay Module**. The LPM is most often used with Analog and Pulse Inputs. The LPM has little effect with an RTD module; however, the LPM protects the I/O rack and other modules.

A.2 Initial Installation

The LPM plugs into any of the field terminal block sockets located on the termination board. To add an LPM to protect a built-in analog I/O channel or an I/O module, perform the following steps. Refer to Figure A-2.

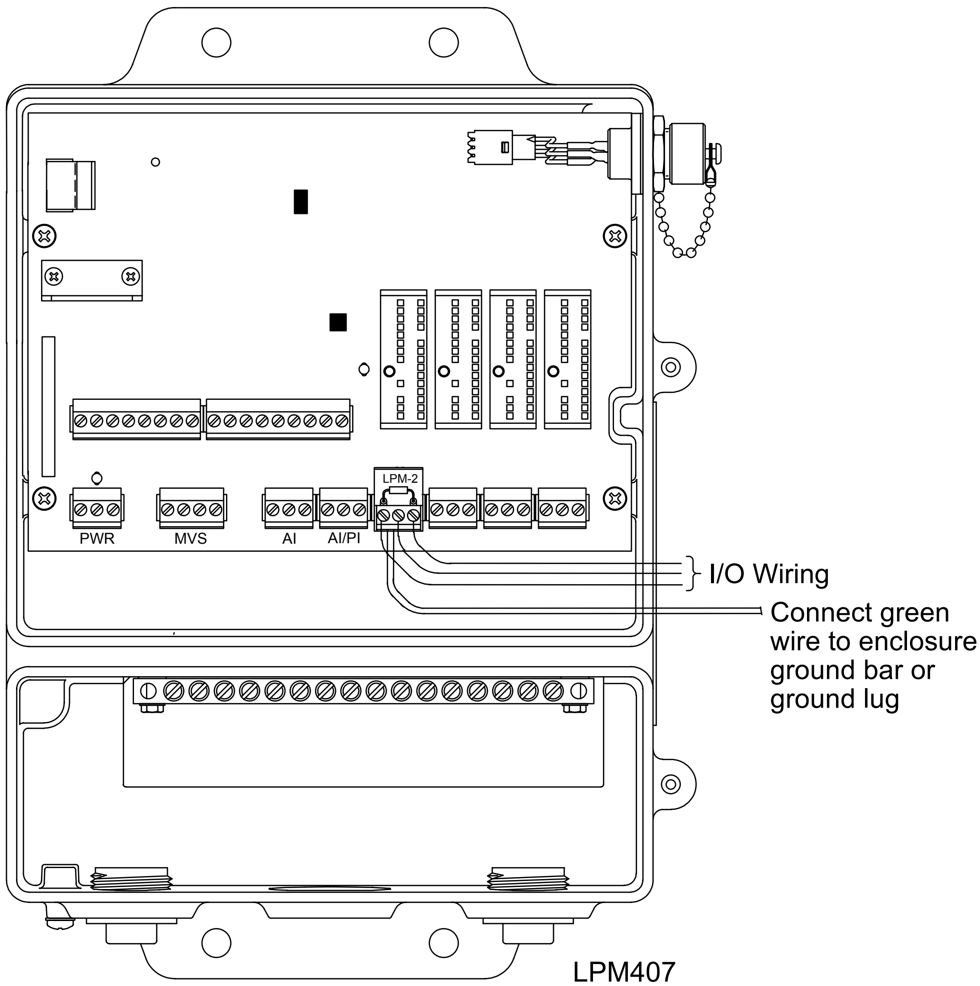


Figure A-2. Typical Lighting Protection Module Installation

CAUTION

Do not use the Lightning Protection Module cannot be used with a 120 volts ac signal on a DO Relay Module.

CAUTION

If you are installing an LPM on a FloBoss currently in service, and there is a field device connected to the I/O channel that will receive the LPM, make sure the field device will not be left in an undesirable state when it is disconnected from the FloBoss.

1. Unplug the field wiring termination block from the socket of the channel for which the LPM is going to be installed.

2. Plug the LPM into the field wiring terminal block socket located in step 1.
3. Connect the LPM ground wire to the ground bus bar. This ground bar must in turn be connected to a good earth ground. Do not use the power system ground for this connection.
4. Transfer any field wiring from the unplugged termination block to the built-in termination block on the LPM.

A.3 Connecting the LPM to Wiring

There is a one-to-one correspondence between the LPM terminals and the terminals of the I/O channel being protected. If you are connecting field wiring to the LPM, refer to the I/O wiring information in Section 3, Input/Output Modules.

- ❖ **NOTE:** The LPM module provides sockets for a plug-in range (scaling) resistor. These sockets, which are internally connected to the module's middle and right-most screw terminals, must be used when installing a range resistor for a built-in Analog Input channel. For an Analog Input module or any other module using a scaling resistor, either the sockets on the I/O module or on the LPM may be used for the scaling resistor.

The LPM module provides a ground wire for connection to the enclosure ground bar or ground lug. The enclosure ground bar or ground lug must in turn be connected to a good earth ground. Do not use the power system ground for this connection.

A.4 Troubleshooting and Repair

The Lightning Protection Modules function by shunting the high voltage transients through gas discharge tubes to the ground lead. In the event of an I/O signal failure, verify the signal is not interrupted by the LPM. Proceed to the troubleshooting and repair procedures for I/O in previous sections of this manual.

Before removing an LPM, make sure all devices and processes remain in a safe state. Remove the LPM and disconnect the field wiring. Remove any range resistors from the LPM. With a digital multimeter, verify continuity through each connector socket to the corresponding field wiring terminal. If there is no continuity, replace the LPM.

With a digital multimeter, check each of the input terminals for continuity to the ground lead. If the test shows continuity to the ground lead, replace the LPM.

A.5 Lightning Protection Module Specifications

The following specifications are for the LPM.

Lightning Protection Module Specifications	
ELECTRICAL **Series Resistance:** 10 Ω from input to output, each terminal. **DC Clamping Voltage:** 72 to 108 V dc. **100 V/ms Impulse Clamping Voltage:** 500 V maximum. **Clamping Release Voltage:** 52 V minimum. **10 KV/µs Impulse Clamping Voltage:** 900 V maximum. **Surge Life:** Module can withstand 300 surges of 10 to 1000 µs duration at 500 A minimum. **Insulation Resistance:** 10,000 MΩ minimum. **Capacitance:** 1.0 pF maximum @ 1 MHz, each terminal.	**CASE** **Material:** ABS polycarbonate thermoplastic. **Dimensions:** 17 mm H by 21 mm W by 40 mm D (0.65 in. H by 0.84 in. W by 1.58 in. D). **Length of Ground wire:** 1.2 m (48 in) nominal. **SURGE WITHSTAND** Meets surge requirements IEEEC62.31. **ENVIRONMENTAL** Meets the Environmental specifications of the FloBoss in which the module is installed, including Temperature, Humidity, and Transient Protection. **WEIGHT** 34 grams (1.2 ounces). **APPROVALS** Approved by CSA for hazardous locations Class I, Division 2, Groups A, B, C, and D.

APPENDIX B – MULTI-VARIABLE SENSORS

This appendix describes the Multi-Variable Sensor (MVS) devices, which provide differential pressure, static pressure, and temperature inputs to the FloBoss 407 for orifice flow calculation. Topics include:

B.1 Description

The MVS205 Multi-Variable Sensor provides static pressure, differential pressure, and process temperature inputs. The inputs from the MVS are used in performing orifice flow calculations. The MVS205 operates as a remote or integral unit that communicates via a serial format.

Functionally, the MVS is a sensor device that measures three flow-related variables simultaneously. These variables are continuously available to the FloBoss that polls the MVS. Two versions of the MVS are available:

- **MVS205P** with reference accuracy of 0.075%.
- **MVS205E** with reference accuracy of 0.10%.

The MVS consists of a transducer and an interface circuit. The transducer, contained in the sensor body, uses capacitance-cell technology to sense differential pressure and piezo-resistive technology to sense the static (absolute or gauge) pressure.

The transducer electronics convert the pressure variables directly into a digital format, allowing accurate correction and compensation. The raw temperature is converted by the interface board into digital format. A microprocessor linearizes and corrects the raw pressure signals (from the sensor) using characterization data stored in non-volatile memory.

The interface circuit allows the MVS to connect to and communicate with a FloBoss using a serial 4-wire EIA-485 (RS-485) connection. In a Remote MVS, this interface circuit board is enclosed in an explosion-proof electronics head.

An external three- or four-wire RTD is used to sense the process temperature. **The RTD sensor is connected directly to the interface circuit board** of the MVS. A separate RTD cable assembly is required for the connection.

Attached to the bottom of the sensor body is a Coplanar™ flange. This flange, which provides drain/vent valves, allows the MVS to be mounted on a pipestand, on a wall or panel, or on an integral orifice assembly or manifold valve.

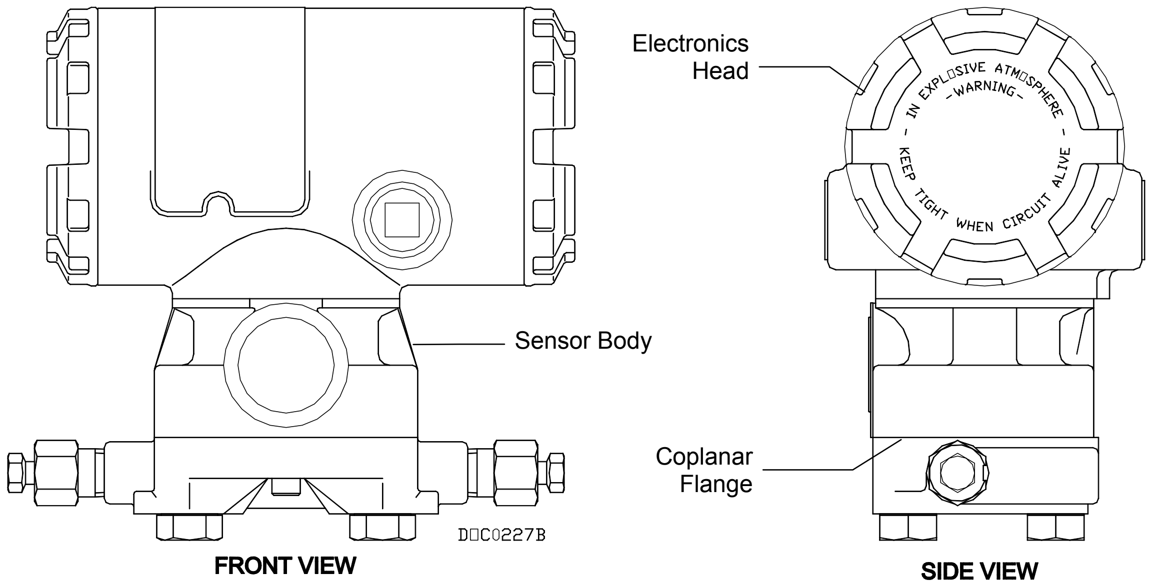


Figure B-1. MVS205 Remote Multi-Variable Sensor

B.2 MVS Mounting

MVS mounting depends on whether it is an Integral or Remote MVS. The Integral MVS205 is factory-mounted directly to the FloBoss 407 enclosure. This mounting uses a special coupler to join the threads on the MVS to the center wiring hole in the bottom of the FloBoss 407 enclosure. Refer to Figure B-2, which shows outline and mounting dimensions. A mounting (stiffening) plate fastened to the MVS and the FloBoss 407 enclosure provides rigidity to the assembly. In this type of mounting, the MVS interface circuit is factory-installed inside the lower compartment of the FloBoss 407 enclosure.

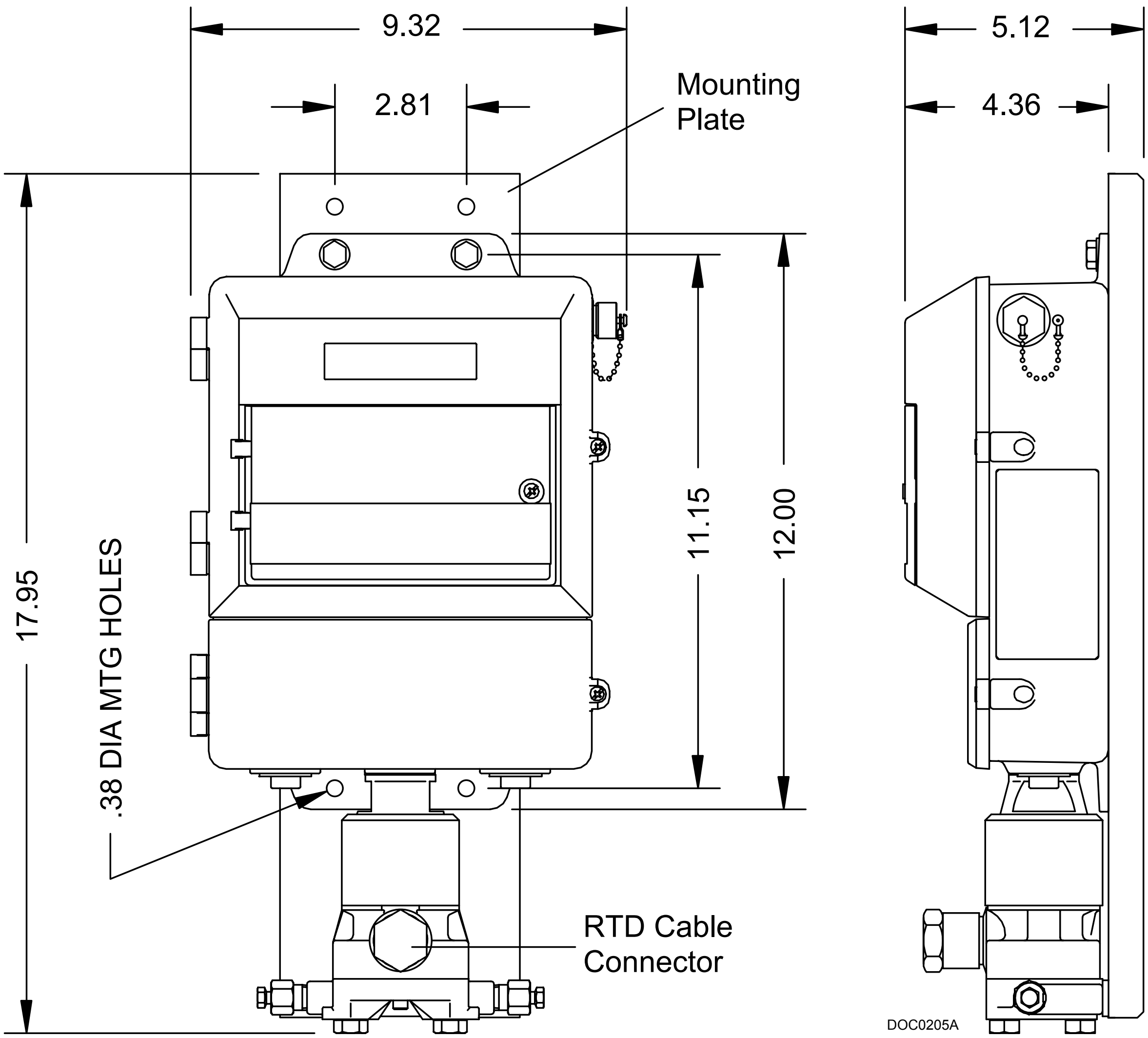


Figure B-2. FloBoss 407 and Integral MVS Outline and Mounting Dimensions

The FloBoss 407 with an Integral MVS can be pipe-mounted with the use of mounting blocks and U-bolts, or it can be panel mounted with 5/16-inch (8 mm) bolts. When the MVS is pipe or panel mounted, the pressure inputs must be piped to the ¼-18 NPT connections on the MVS, as shown in Figure B-3. The FloBoss 407 with an Integral MVS can also be mounted directly on a manifold valve or an integral orifice assembly.

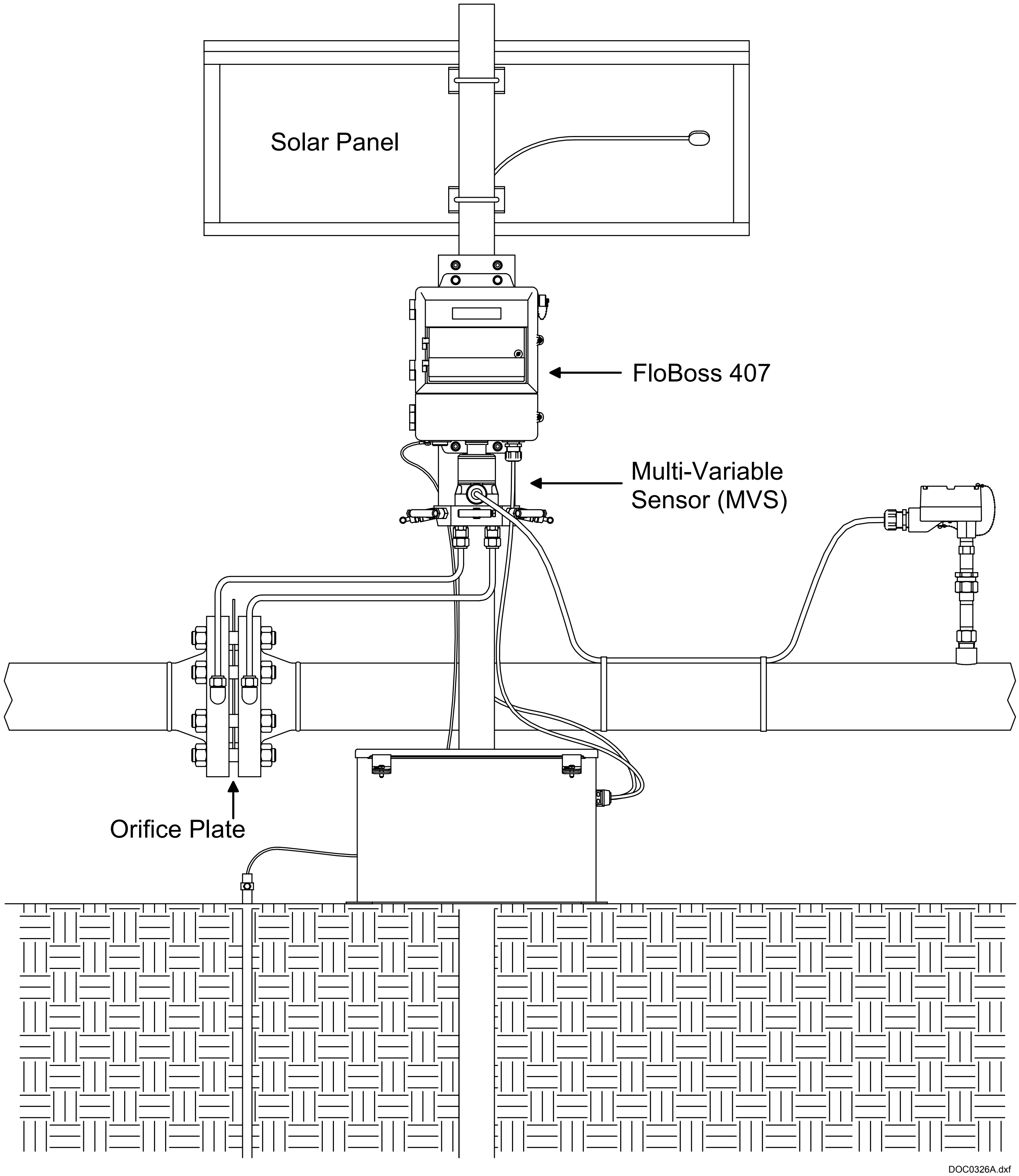


Figure B-3. Pipe Mounting of FloBoss 407 with Integral MVS

The Remote MVS uses a transmitter-style head to house the interface electronics. The interface circuit board is factory-mounted inside the head, which provides protection for the electronics, a place for termination of the field wiring, and ratings for hazardous locations.

The Remote MVS can be mounted to a pipe or panel (Figure B-4 and Figure B-5) with the optional bracket kit, which includes an L-shaped bracket and a pipe clamp. The bracket attaches to the Coplanar flange on the MVS. The process pressure inputs are piped to the ¼-18 NPT connections on the bottom of the MVS or to an intervening manifold valve. The MVS can also be mounted directly (not shown) to flange taps using a manifold valve or an integral orifice assembly.

The MVS is an upstream device. The static pressure line normally connects to the high-pressure side of the sensor, and the upstream values are calculated. To use the MVS with a FloBoss 407 as a downstream device or in bi-directional flow conditions, refer to the *ROC/FloBoss Accessories Instruction Manual* (Form A4637).

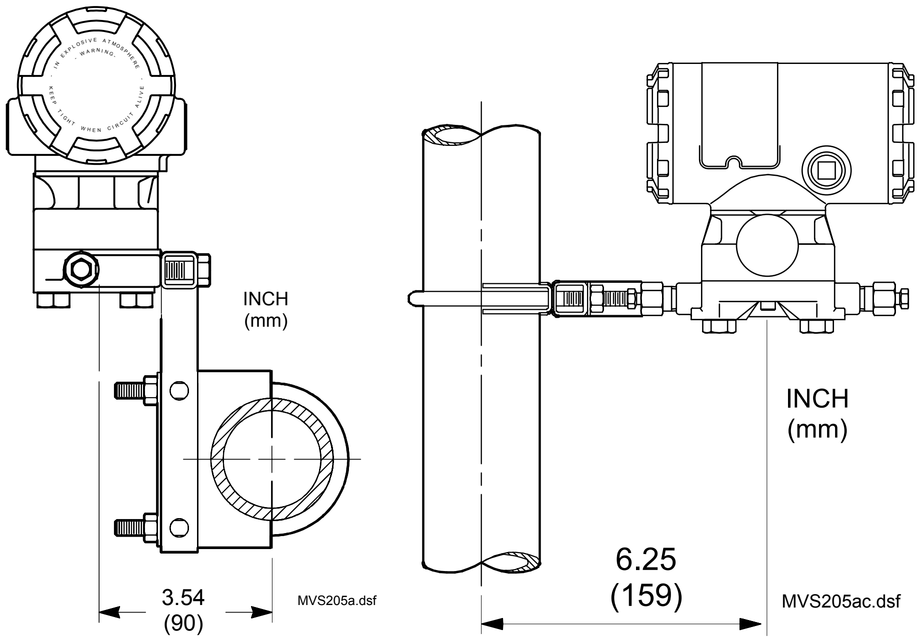


Figure B-4. MVS Remote Pipe Mounting (Horizontal and Vertical Pipe)

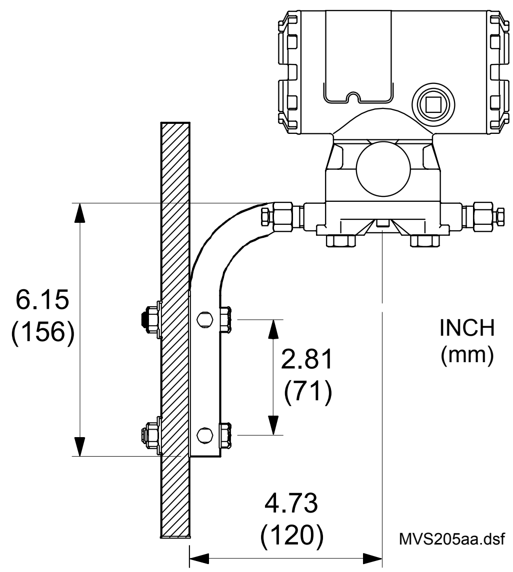


Figure B-5. MVS Remote Panel Mounting

B.3 MVS Field Wiring

For an Integral MVS, the FloBoss 407 and the Multi-Variable Sensor are shipped from the factory with the wiring connected as shown in Figure B-6. The factory wiring uses yellow, blue, red, and black wires (from left to right) in the MVS terminal block.

In FloBoss 407 installations with one or more Remote MVS units, the signal wiring between the FloBoss 407 and the Remote MVS is connected as follows. Use Sealtite or a similar product to provide a conduit path from the Remote MVS to the FloBoss 407. An armored cable requires no conduit to be used in a Class I, Division 2 hazardous non-incendiary area. In a Class I, Division 1 area, unarmored cable may be used if installed in conduit and have seals per hazardous installation practices. **All installation wiring must follow code to meet the respective Class and Division ratings.**

To configure a multi-drop MVS setup, connect each MVS to the FloBoss unit one at a time. Make sure that each MVS is functioning correctly before installing the next MVS.

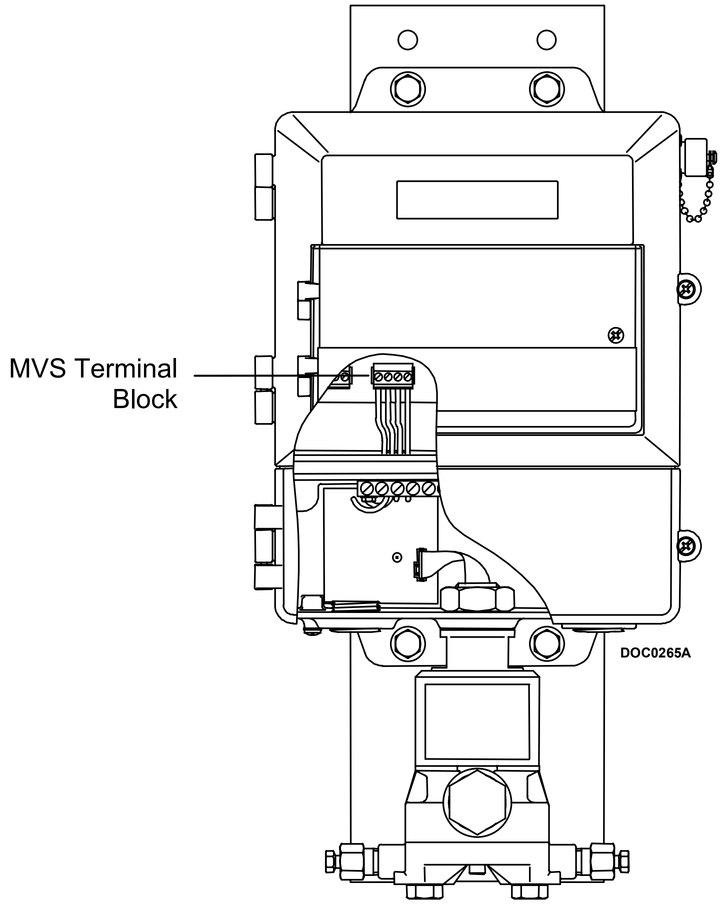


Figure B-6. Signal Hook-Up for a Integral MVS Installation

CAUTION

Before connecting a Remote MVS to the FloBoss 407, remove all power from the MVS by unplugging the power to the FloBoss 407. If you do not remove ALL power, electronic components will be damaged. Refer to Section 2, Backup Procedure Before Removing Power.

- **NOTE:** For Measurement Canada units, maintenance and resealing of the FloBoss must be performed by authorized personnel only.
- **NOTE:** There is a possibility of losing the FloBoss configuration and historical data held in RAM while performing the following procedure. As a precaution, save the current configuration and historical data to permanent memory.

⚠ CAUTION

When installing units in a hazardous area, make sure all installation components selected are labeled for use in such areas. Installation and maintenance must be performed only when the area is known to be non-hazardous. Installation in a hazardous area could result in personal injury or property damage.

⚠ CAUTION

To avoid circuit damage when working with the FloBoss, use appropriate electrostatic discharge precautions, such as wearing a grounded wrist strap.

⚠ CAUTION

During this procedure, all power will be removed from the FloBoss and devices powered by the FloBoss. Ensure that all connected input devices, output devices, and processes will remain in a safe state when power is removed and when power is restored.

1. Remove power from the FloBoss.
2. Run four wires from the FloBoss 407 to the Remote MVS, and connect them to the MVS terminal block on the termination board. The wires should be a minimum size of 22 AWG and a maximum length of 1220 meters (4000 feet). Two of the terminals provide power and the other two terminals provide a communication path.

The MVS is labeled as follows with terminal 1 on the left and terminal 8 located on the right:

Terminal	Usage
A	+ Signal
B	– Signal
RTD REF	RTD REF
RTD +	RTD +
RTD –	RTD –
RTD RET	RTD RET
+	+ Power
–	– Power

CAUTION

Do not reverse polarity of the power wires (+ and –) while wiring the Remote MVS units or circuits may be damaged. Double-check for proper connections before applying power.

1. The terminals in the MVS head are labeled the same as the terminals on the MVS terminal block in the FloBoss 407. Connect the FloBoss 407 and Remote MVS terminals one for one:
   - A to A
   - B to B
   - "+" to "+"
   - "–" to "–"

   Figure B-7 shows wiring for a typical Remote MVS installation.
2. Connect the Remote MVS to a suitable earth ground per applicable codes and standards. Two means of grounding are available on the unit: internal and external. To use the internal ground to meet U.S. and Canadian requirements, connect to the ground terminal inside. To meet IEC and CENELEC requirements, use the external ground lug to connect to earth ground.

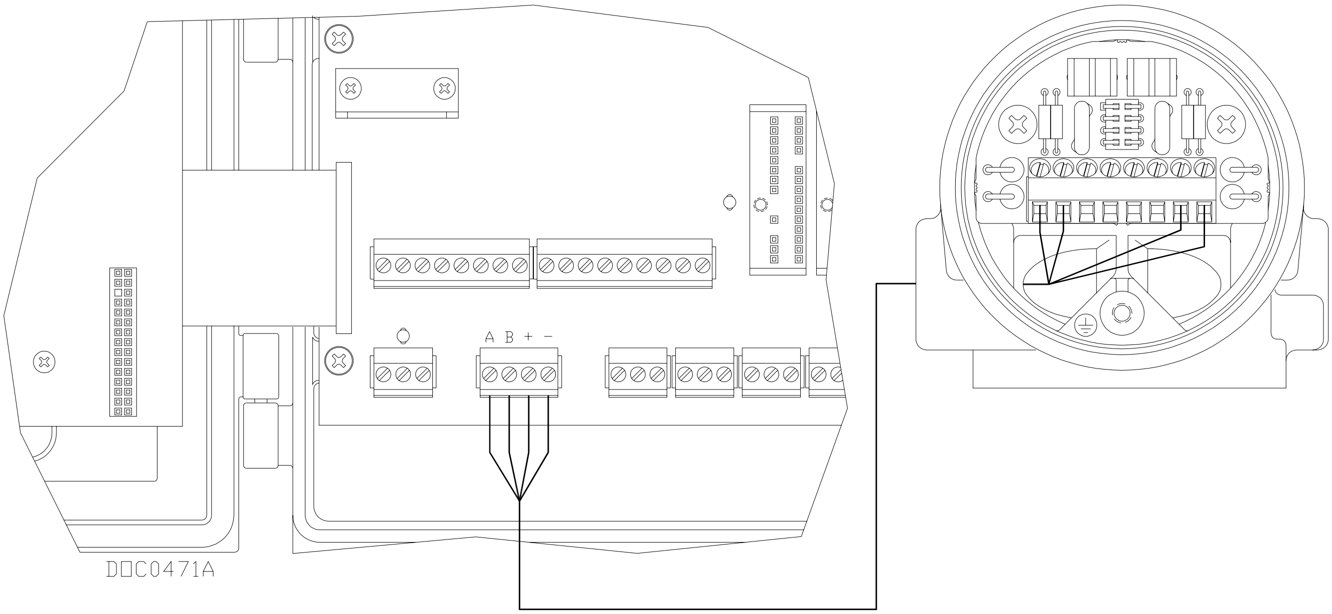


Figure B-7. Signal Hook-Up for a Remote MVS Installation

3. **The Address of each MVS must be set prior to final wiring of multiple MVS devices.** For proper operation of multiple MVS devices, each MVS device must have a unique Address. The FloBoss 407 allows up to four MVS devices to be connected on its communications bus in a multi-drop connection scheme.
4. Once a unique Address is set for each MVS in the **multi-drop configuration**, connect like terminals to like. This means all the "A" terminals on the devices are electrically connected to the FloBoss "A" terminal and so on. The wiring can be done entirely from the FloBoss with an individual cable to each Remote MVS, or by wiring in parallel (**daisy-chain**) though each Remote MVS.

Pay close attention to not reverse the power wires. These connections should always be made with power removed from the FloBoss 407. Double-check for proper orientation before applying power. If the connections are reversed and power is applied, the MVS and the FloBoss 407 processor board may be damaged.

B.3.1 MVS Lightning Protection

To safeguard against lightning strikes, install surge suppression devices. The following commercially available lightning protection modules have been found to meet requirements:

- Model Number LPC 10643 – 485: Protects the communication pair (A and B terminals).
- Model Number LPC 10643 – 1: Protects the power and ground pair ("+" and "–" terminals).

These units are available from:

Lightning Protection Corporation
PO Box 6086
Santa Barbara, CA 93160
Telephone: 1-800-317-4043
http://www.lightningprotectioncor.com/

B.3.2 RTD Wiring

An RTD sensor assembly containing an element with an alpha of 0.00385 is typically used with the MVS205 sensor. Refer to the *ROC/FloBoss Accessories Instruction Manual (Form A4637)* for installation information.

Resistance Temperature Detectors (RTD) are transducers typically used to sense the temperature of a gas or fluid in a pipe. An RTD sensor can provide a signal to an RTD input module in a MVS, or to the RTD input of a FloBoss 407. The following RTD assemblies include an RTD element in a protective thermowell and a connection head with screw terminals.

- Model TW25 – RTD Element, –100 to 400°C (–148 to 752°F), with 2.5-inch thermowell, 4-wire.
- Model TW45 – RTD Element, –100 to 400°C (–148 to 752°F), with 4.5-inch thermowell, 4-wire.

These assemblies use a 100-ohms platinum RTD element. The spring-loaded element has an alpha of 0.00385 and can be used to measure temperatures in the range of –100 to 400°C (–148 to 752°F).

The element is encased in a 316 Stainless Steel thermowell, with a choice of either a 2.5 or 4.5 inch immersion length. The tapered-style thermowell mounts in a ¾-14 NPT hole. An explosion-proof connection head, union, and nipple are included in the assembly. The connection head meets requirements for Class I, Division 1, Groups C and D hazardous locations. Refer to Figure B-8.

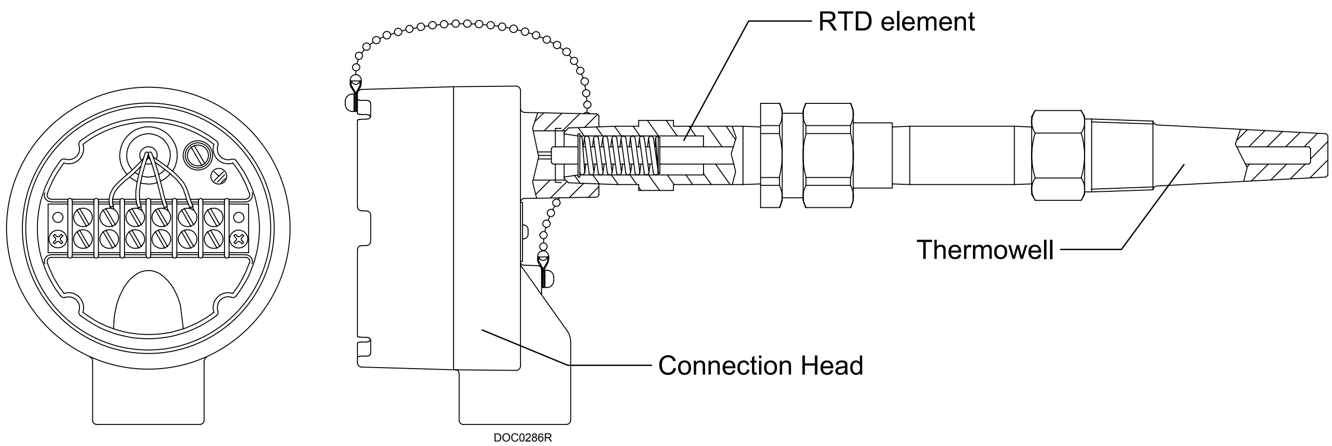


Figure B-8. RTD Assembly Details

B.4 Configuring the MVS

Use ROCLINK configuration software to configure the MVS and to set the unique interface Address. This is essential if there is more than one MVS connected to a FloBoss 407 (multi-drop configuration).

All MVS units are sent from the factory with a default interface Address of "1". This allows for first-time communications to be accomplished. Do NOT use Address 240 in multi-drop applications, because all MVS devices with this address will try to respond to requests from the FloBoss.

To configure a multi-drop MVS setup, connect each MVS to the FloBoss 407 one at a time. Ensure that each MVS is functioning correctly before installing the next MVS.

Once a unique Address is set for each MVS, connect the MVS units as instructed in Section B.3, MVS Field Wiring, on page B-6.

❖ **NOTE:** Refer to the *ROC/FloBoss Accessories Instruction Manual* (Form A4637), *ROCLINK for Windows Configuration Software User Manual* (Form A6091), and *ROCLINK 800 Configuration Software User Manual* (Form A6121).

B.5 Calibrating the MVS

The Calibration routine provides Verify, Calibrate, and Zero Shift functions for each input (AI, MVS, and RTD) or the meter run. You can calibrate Differential Pressure (orifice metering only; may be High or Low Differential Pressure, depending on the device), Static Pressure, or Temperature. Calibration parameters include Set Zero, Set Span, and Set Midpoint 1, 2, and 3. This allows you to specify the low calibration point between the Zero and Span endpoints. The Zero and Span endpoints are used in setting the Midpoints. Midpoints 1, 2, and 3 are values set between the Zero and Span values.

To perform initial calibration or recalibration, such as after an orifice plate is changed, use ROCLINK configuration software, or the FloBoss 407 Keypad. The following procedure is performed using the Keypad.

All new calibration values are automatically logged in the Event Log.

❖ **NOTE:** When calibrating Stacked Differential Pressure, you may calibrate either the low differential pressure (Low DP) input or the high differential pressure (Diff Pressure) input.

❖ **NOTE:** During calibration, the FloBoss time-outs and disconnects if it is left idle for an extended period. You lose calibration values and must reconnect to start calibration from the beginning.

CAUTION

If you have an MVS sensor, refer to the Sensor Calibration section in the ROC/FloBoss Accessories Instruction Manual for the recommended way to remove/restore the MVS from/to working pressure during calibration. Failure to follow recommendations may cause sensor damage.

1. Set up the pressure calibrator and make the necessary connections to the MVS.

   ❖ **NOTE:** Because any calibration changes are recorded in flash memory, the power supplied to the FloBoss 407 must be at least 12.5 volts. If it is not, the changes are not saved and the previous settings may be lost.

   ❖ **NOTE:** To properly perform the calibration procedure, you must know if the FloBoss 407 and MVS is set up to sense absolute pressure or gauge pressure.

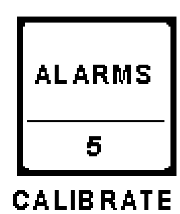
2. To start the Keypad calibration, activate the display and enter the user Password.

   ♦ In any of the scrolling list displays, press HOLD DISPLAY to stop the scrolling and use the UP and DOWN arrow keys to move through the list.

   ♦ At any time during calibration, press ALT and CANCEL to quit.

   ♦ Press EXIT to navigate backwards in the calibration process.

3. Press **ALT** and **CALIBRATE** on the Keypad. The following sequence begins:



4. Press ↓ and **ENTER** to select a meter run.

   Press EXIT to stop calibration.

Select Meter Run
TAG Meter #1
TAG Meter #2
Exit

Calibration Step 1

5. Press **ENTER** to advance to the Freeze Values Menu.

Push ENTER to go to
Freeze Values Menu

Calibration Step 2

Freeze stops the values of the Differential Pressure, Low Differential Pressure, Static Pressure, and Temperature from being updated during verification or calibration. This effectively "freezes" the values used in ongoing processing, such as history logging, while calibration is being performed.

6. Add the desired **Freeze Values**.
7. Press ↓ to select an input (DP READING, PRESS READING, TEMP READING) and press **ENTER**.
8. Key in the **Freeze Value** and press **ENTER**.
9. **Repeat** for each input.
10. Press ↓ to select FREEZE THE METER and press **ENTER** to freeze all inputs at their current or entered values.

    Press EXIT to return to Calibration Step 1.

TAG OF METER DATA
DP Reading
Press Reading
Temp Reading
Freeze the Meter
Exit

Calibration Step 3

11. Press ↓ to select an input (DP READING, PRESS READING, TEMP READING) for calibration and press **ENTER**.

Select Meter Input
DP Reading
Press Reading
Temp Reading
Exit

Calibration Step 4

DP Reading – When the sensor is configured for Downstream operation, apply the calibrator pressure to the low (labeled "L") side of the sensor. Enter the value as positive, even though the Live Reading is a negative value. The software automatically compensates.

Press Reading – For **Static Pressure** on an absolute-pressure device, remember to add in the actual atmospheric pressure, such as 300 + 14.73. Static Pressure for Downstream is calibrated the same as for Upstream.

A different display appears depending upon which input you select:

- **Calibrate** – Calibrate the currently selected input.
- **Exit** – Press EXIT to return to Step 4 and select another input.
- **Zero Shift Effect** – Set the working pressure for a DP Reading.
- **Verify** – Verify the current setting of an input.

12. Press ↓ to select **ZERO SHIFT EFFECT** and press **ENTER** to set the DP Reading.

DP Reading
Calibrate
Exit
Zero Shift Effect
Verify

Calibration Step 5

13. Press ↓ to select **ZERO SHIFT EFFECT** and press **ENTER** to set the DP Reading.

DP Reading
Zero Shift Effect
Verify
Calibrate
Exit

Zero Shift Effect

14. Key in the working pressure, let it stabilize.
15. Press ↓ to select **SAVE** and press **ENTER**.

    Save stores the Zero Shift Data, logs the event, and returns to Calibration Step 5.

    Exit discards the data and returns to Calibration Step 5.

Adjust Zero Shift	
Zero Shift	DATA
Save	
Exit	

Adjust Zero Shift

16. Press ↓ to select **VERIFY** in Calibration Step 5 to verify the selected input and press **ENTER**.

If the run has been calibrated before, verify the calibration at a point in the operating range, such as at 0, 25, 50, 75, or 100 percent and set up the input with the desired applied test value (App. Value).

- **App. Value** – Applied test value that you enter.
- **Cur. Value** – Current value.
- **Accuracy** – Accuracy computed as the difference.

17. Press ↓ to select **APP. VALUE** and press **ENTER**.

    Applied Value is the input desired for the test value and is the actual value expected by the test equipment being calibrated against. For example: When calibrating temperature for an RTD input, enter the degree value associated with the resistance set up in the decade box.

Verify Calibration	
App. Value	DATA
Cur. Value	DATA
Accuracy	DATA
Log Verif.	
Exit	

Verify Calibration Display

Compare this value with the Current Value. If the value is too far out of tolerance, be sure to perform calibration for the input.

18. Key in a **test value** (in engineering units) and press **ENTER** to save the corresponding test value.

19. Press ↓ to select **LOG VERIF.** and press **ENTER** to log the last verified value to the Event Log.

20. EXIT returns the program to Calibration Step 5.

21. Press ↓ to select **CALIBRATE** in Calibration Step 5 to calibrate the selected input and press **ENTER**.

Calib. Minimum Scale	
App. Value	DATA
Cur. Value	DATA
Save	
Exit	

Minimum Scale Calibration

Use the Calib. Minimum Scale display to set the Zero value (0% of range) for the in Differential Pressure (orifice only), Static Pressure, or Temperature. This should correspond with the Low Reading Timer (0% Count) and is the low value for the meter run.

22. Press ↓ to select **APP. VALUE** and press **ENTER**.

23. Key in the **minimum scale value** and press **ENTER** to save the value.

24. Press ↓ to select **SAVE** and press **ENTER** to log the value to the Event Log and continue to the Calib. Maximum Scale display.

EXIT returns the program to Calibration Step 5.

Calib. Maximum Scale	
App. Value	DATA
Cur. Value	DATA
Save	
Exit	

Maximum Scale Calibration

Use the Calib. Maximum Scale display to set the Span value (100% of range) for Differential Pressure (orifice only), Static Pressure, or Temperature. This should correspond with the High Reading Timer (100% Count) and is the **high value** to the input (the top end of the expected operating range).

25. Press ↓ to select **APP. VALUE** and press **ENTER**.

26. Key in the **maximum scale value** and press **ENTER** to save the value.

27. Press ↓ to select **SAVE** and press **ENTER** to log the value to the Event Log and continue to the CALIB. MORE POINTS? display.

EXIT returns the program to Calibration Step 4.

Calib. More Points?
No
Yes

Calib. More Points?

28. Press ↓ to select **NO** and press **ENTER** to return to SELECT METER INPUT (Step 4) or press ↓ to select **YES** and continue to the CALIB. MID. POINT #1, 2 , 3 display.

Calibrate Midpoint 1, such as 25% of range, to specify the low calibration point between the Zero (Calib Minimum Scale) and Span (Calib Maximum Scale) endpoints. The Zero and Span endpoints you recently established are used in setting the Midpoints. **Midpoints 1, 2, and 3 are values set between the Zero and Span values**.

Midpoint 1 should have the lowest value of the three midpoints and should be between the Zero and Span values.

Calibrate Midpoint 2, such as 50% of range, to specify the middle calibration point between the Zero and Span endpoints. Midpoint 2 should be the middle value (magnitude) between Midpoint 1 and Midpoint 3.

Calibrate Midpoint 3, such as 75% of range, to specify the high calibration point between the Zero and Span endpoints. Midpoint 3 should be the high value (magnitude) above Midpoint 1 and Midpoint 2.

Calib. Mid. Point #1, 2, 3	
App. Value	DATA
Cur. Value	DATA
Save	
Exit	

Midpoint Calibration Display

29. Press ↓ to select **APP. VALUE** and press **ENTER**.
30. Key in the **lowest Mid-point 1 input** on the calibrator press **ENTER**.
31. Press ↓ to select **SAVE** and press **ENTER** to log the value to the Event Log and continue to the CALIB. MORE POINTS? display.
32. Repeat the procedure for **Mid-points 2** and **3** as required.

    After saving Mid-point 3 or selecting EXIT, the program returns to SELECT METER INPUT (Calibration Step 4).

Save Calib. Data?
No
Yes

Save Calib. Data?

33. Press ↓ to select **EXIT** from SELECT METER INPUT (Calibration Step 4) and press **ENTER**.
34. The **Save Calib. Data?** display appears.

- Press ↓ to select **YES** and press **ENTER** to log the value to the Event Log and save the calibration values
- Press ↓ to select **NO** and press **ENTER** to delete the calibration changes restores old calibration data.

  The program proceeds to the SELECT METER RUN display (Calibration Step 1).

35. Press ↓ to select **EXIT** and press **ENTER** from SELECT METER RUN (Calibration Step 1) to return to the date and time display and exit the calibration program.

B.6 MVS Troubleshooting and Repair

It is very important that the MVS be removed or replaced without power connected.

CAUTION

When replacing an MVS, remove all power from the MVS by pulling out the MVS connector (plug P8) on the FloBoss 407. If you do not remove ALL power from the MVS, electronic components may be damaged.

If more than one MVS is connected to the FloBoss 407, make sure that each has a unique Address, as explained in Section B.4, Configuring the MVS, on page B-10. Use ROCLINK configuration software to establish each unique MVS Address.

If your MVS displays letters (such as NAN0) for any of the input readings, there is likely a floating point error in the sensor. Attempt to reset the MVS back to factory default settings.

If you believe an MVS is damaged or faulty, contact your local sales representative for repair or replacement.

If you are having difficulty communicating with an MVS unit, reset the MVS to factory default settings.

To restore factory default settings in an MVS:

1. Connect the FloBoss 407 to a PC running ROCLINK configuration software.
2. Select Utilities > **MVS Calibration**.
3. Click **Set Back to Factory Defaults**.
4. Click **Yes**.

B.7 Multi-Variable Sensor Specifications

For Multi-Variable Sensor Specifications, refer to Specifications Sheet 2.5:MVS205.

APPENDIX C – I/O SIMULATION

This appendix describes how to simulate inputs and outputs to verify the proper operation of the FloBoss. The simulations make use of the various types of I/O modules available for the FloBoss. Topics covered are:

C.1 Analog Outputs to Analog Inputs

The Analog Output source module simulates a transmitter by feeding a 4 to 20 milliamps current to either an Analog Input Loop module or an Analog Input Differential module. Figure C-1 and Figure C-2 show wiring connections.

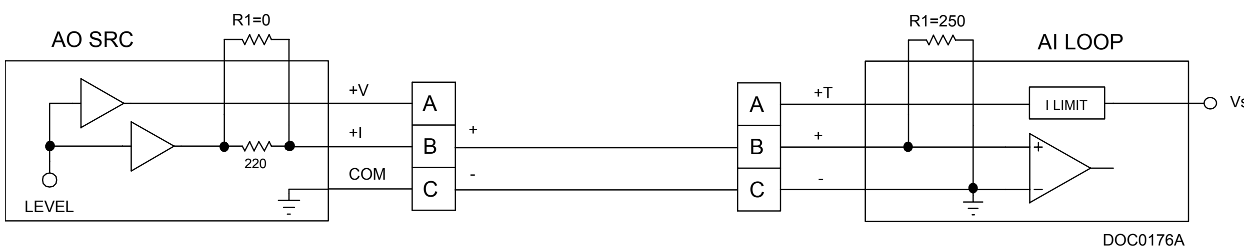


Figure C-1. Current Loop — AO Source Module to AI Loop Module

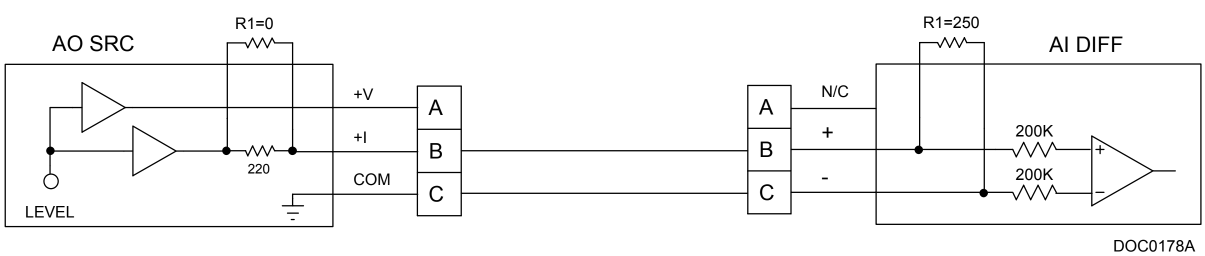


Figure C-2. Current Loop — AO Source Module to AI Differential Module

The Analog Output Source module simulates a transmitter feeding a 0 to 5 volts dc signal to an Analog Input differential module. Figure C-3 shows wiring connections.

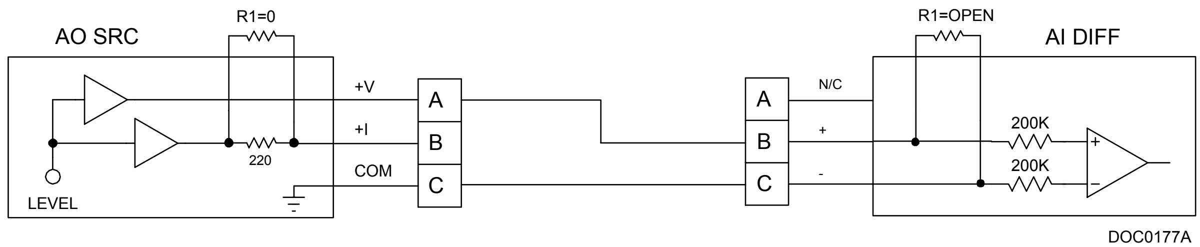


Figure C-3. Voltage Input — AO Source Module to AI Differential Module

C.2 Analog Outputs to Ammeter or a Volt Meter

Figures C-4 and C-5 show how to use a ammeter or a volt meter to check an Analog Output Source module by directly reading the current or voltage from the module.

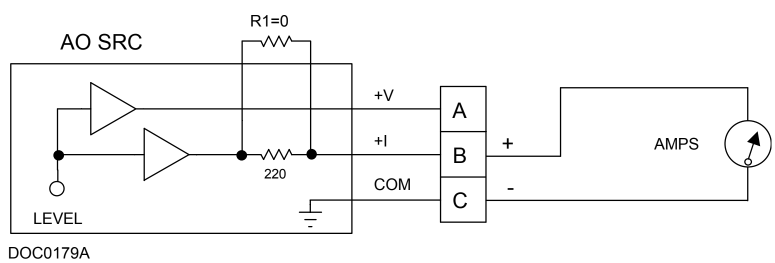


Figure C-4. Current Loop — AO Source Module to Ammeter

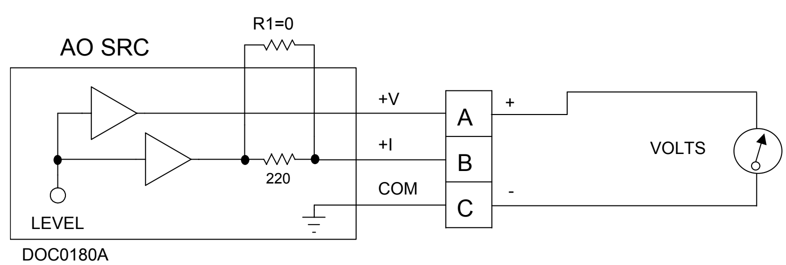


Figure C-5. Voltage Output — AO Source to Voltmeter

C.3 Discrete Outputs to Discrete Inputs

Figure C-6 shows how to use a Discrete Output Source module to simulate a device transmitting a discrete voltage level to a Discrete Input Isolated module.

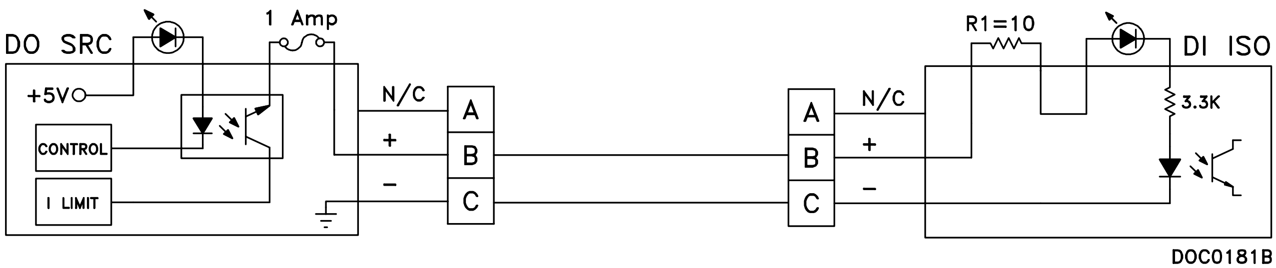


Figure C-6. DO Source Module to DI Isolated Module

Figure C-7 shows how to use a Discrete Output Isolated module to simulate relay contacts to a Discrete Input Source module.

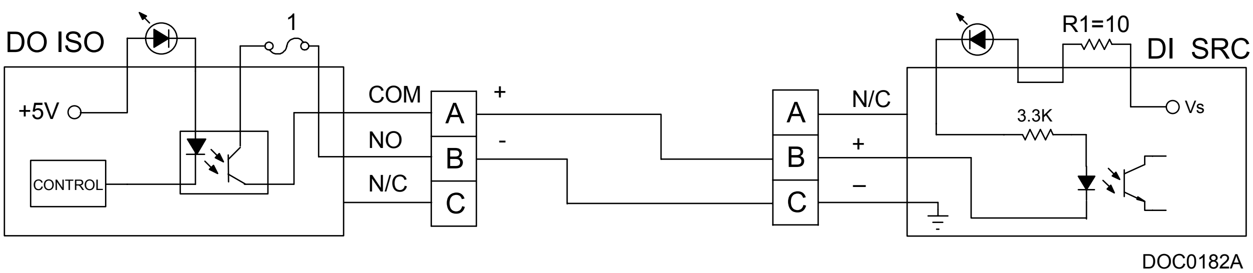


Figure C-7. DO Isolated Module to DI Source Module

C.4 Discrete Outputs to Pulse Inputs

Figure C-8 shows how to use a Discrete Output Source module to simulate a device transmitting pulses such as a turbine meter to a Pulse Input Isolated module.

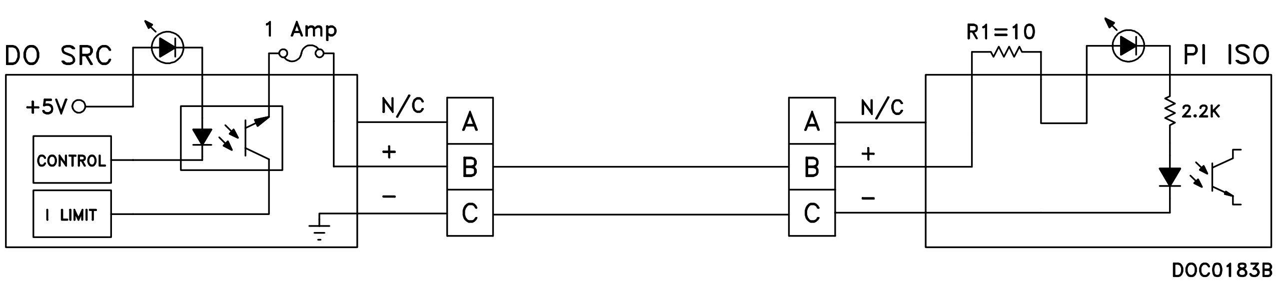


Figure C-8. DO Source Module to PI Isolated Module

Figure C-9 shows how to use a Discrete Output Isolated module simulate a relay contact to a Pulse Input Source module.

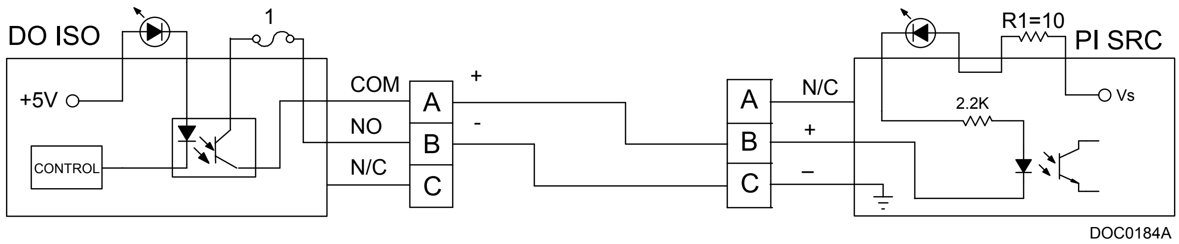


Figure C-9. DO Isolated Module to PI Source Module

C.5 Potentiometer to Analog Inputs

Figure C-10 shows how to use a potentiometer to simulate a transmitter feeding a 4 to 20 milliamps current signal to an Analog Input Loop module.

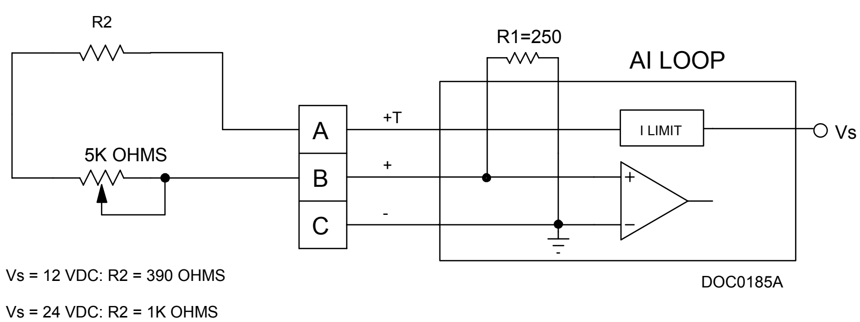


Figure C-10. Potentiometer Input to AI Loop Module

Figure C-11 shows how to use a potentiometer and power source to simulate a transmitter feeding a 4 to 20 milliamps current signal to an Analog Input Differential module.

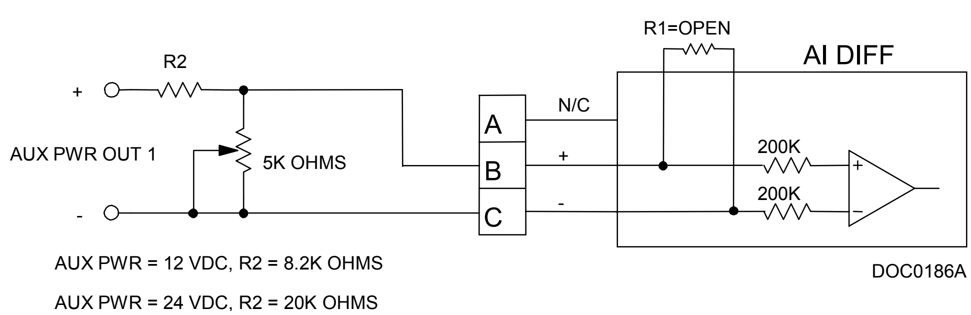


Figure C-11. Potentiometer Input to AI Differential Module

C.6 Switch to Discrete Inputs

Figure C-12 shows how to use a switch and power source to simulate a device transmitting a discrete voltage level to a Discrete Input Isolated module.

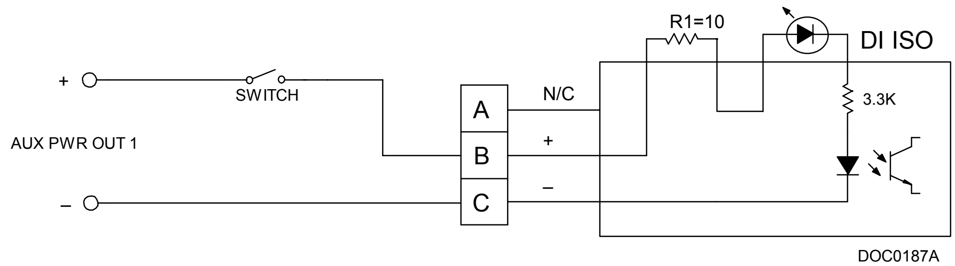


Figure C-12. Switch Input to DI Isolated Module

Figure C-13 shows how to use a switch to simulate relay contacts to a Discrete Input Source module.

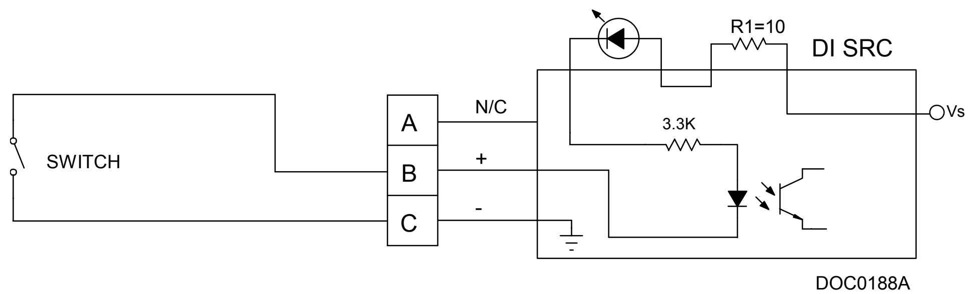


Figure C-13. Switch Input to DI Source Module

C.7 Switch to Pulse Inputs

Figure C-14 shows how to use a switch to simulate relay contacts to a Pulse Input Source module.

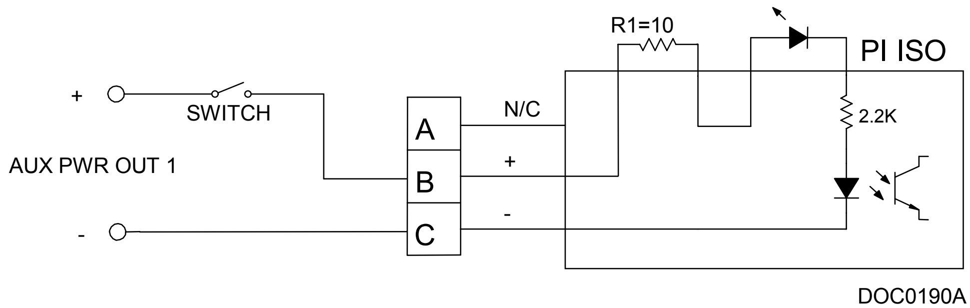


Figure C-14. Switch to PI Source Module

Figure C-15 shows how to use a switch and power supply to simulate a device transmitting discrete pulses (turbine meter) to a Pulse Input Isolated module.

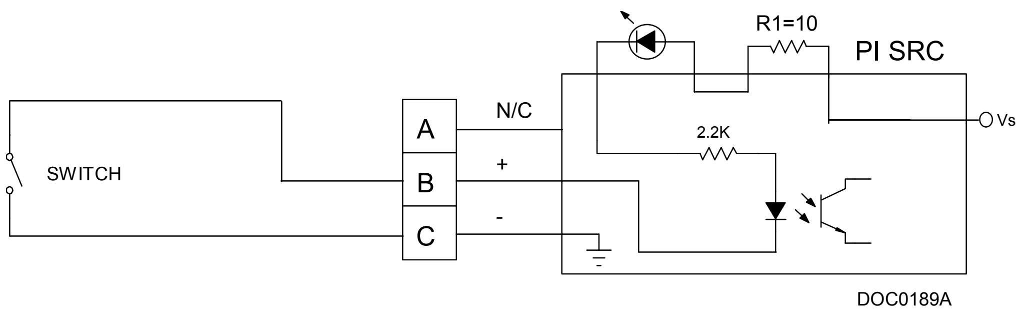


Figure C-15. Switch to PI Isolated Module

GLOSSARY

A

A/D – Analog to Digital.

AGA – American Gas Association.

AI – Analog Input.

AO – Analog Output.

Analog – Analog data is represented by a continuous variable, such as a electrical current signal.

AP – Absolute Pressure.

API – American Petroleum Institute.

ASCII – American Standard Code for Information Interchange.

Attribute – A parameter that provides information about an aspect of a database point. For example, the alarm attribute is an attribute that uniquely identifies the configured value of an alarm.

B

BTU – British Thermal Unit, a measure of heat energy.

Built-in I/O – I/O channels that are fabricated into the FloBoss and do not require a separate module. Also called “on-board” I/O.

C

CMOS – Complementary Metal Oxide Semiconductor. Type of microprocessor used by the FloBoss.

COM1 – Communications port built-in for EIA-232 (RS-232) serial communications.

COM2 – Communications port used for host communications.

Configuration – Refers either to the process of setting up the software for a given system or the result of performing this process. The configuration activity includes editing the database, building schematic displays and reports, and defining user calculations. Typically, the software setup of a device that can often be defined and changed. Can also mean the hardware assembly scheme.

CPU – Central Processing Unit.

CRC – Cyclical Redundancy Check.

CSA – Canadian Standards Association.

CTS – Clear to Send modem communications signal.

D

D/A – Digital to Analog.

DB – Database.

dB – Decibel. A unit for expressing the ratio of the magnitudes of two electric signals on a logarithmic scale.

DCD – **Data Carrier Detect** modem communications signal.
Also, **Discrete Control Device** – A discrete control device energizes a set of Discrete Outputs for a given setpoint and matches the desired result against a set of Discrete Inputs.

Deadband – A value that is an inactive zone above the low limits and below the high limits. The purpose of the deadband is to prevent a value, such as an alarm from being set and cleared continuously when the input value is oscillating around the specified limit. This also prevents the logs or data storage location from being over-filled with data.

DI – Discrete Input.

Discrete – Distinct or non-connected elements. Input or output that is non-continuous, typically representing two levels such as on/off.

DO – Discrete Output.

DP – Differential Pressure.

DSR – Data Set Ready modem communications signal.

DTR – Data Terminal Ready modem communications signal.

Duty Cycle – Proportion of time during a cycle that a device is activated. A short duty cycle conserves power for I/O channels, radios, and such.

E

ESD – Electronic Static Discharge.

EEPROM – Electrically Erasable Programmable Read Only Memory, a form of permanent memory.

EFM – Electronic Flow Metering or Measurement.

EIA-232 – RS-232 Serial Communications Protocol using three or more signal lines, intended for short distances.

EIA-422 – RS-422 Serial Communications Protocol using four signal lines.

EIA-485 – RS-485 Serial Communications Protocol requiring only two signal lines. Can allow up to 32 devices to be connected together in a daisy-chained fashion.

EMF – Electro-motive force.

EMI – Electro-magnetic interference.

ESD – Electro-static discharge.

EU – Engineering Units. Units of measure, such as MCF/DAY.

F

FCC – Federal Communications Commission.

Firmware – Internal software that is factory-loaded into a form of ROM. In the FloBoss, the firmware supplies the software used for gathering input data, converting raw input data calculated values, storing values, and providing control signals.

Flash ROM – A type of read-only memory that can be electrically re-programmed. It is a form of permanent memory (needs no backup power). Also called Flash memory.

FloBoss – A specialized Remote Operations Controller (ROC) from the Flow Computer Division of Emerson Process Management, a microprocessor-based unit that provides remote monitoring and control.

FSK – Frequency Shift Keyed.

FST – Function Sequence Table, a type of program that can be written by the user in a high-level language designed by the Flow Computer Division of Emerson Process Management.

G

GFA – Ground Fault Analysis.

GND – Electrical ground, such as used by the FloBoss power supply.

GP – Gauge Pressure.

H

HART – Highway Addressable Remote Transducer.

hw – Differential pressure.

I, J

I/O – Input/Output.

I/O Module – Module that plugs into an I/O slot on a FloBoss 407 to provide an I/O channel.

ID – Identification.

IEC – Industrial Electrical Code.

IMV – Integral Multiplier Value.

IRQ – Interrupt Request. Hardware address oriented.

IV – Integral Value.

K

Kbytes – Kilobytes. Also referred to as K.

kHz – Kilohertz.

L

LCD – Liquid Crystal Display. Display used for reading data.

LED – Light-emitting diode.

LOI – Local Operator Interface (Local Port). Refers to the serial (EIA-232 / RS-232) port on the FloBoss through which local communications are established, typically for configuration software running on a PC.

LPM – Lighting Protection Module. Use this module to provide lightning and power surge protection for FloBoss units.

LRC – Longitudinal Redundancy Checking error checking.

M

mA – Milliamp(s); one thousandth of an ampere.

MCU – Master Controller Unit.

Modbus – A popular device communications protocol developed by Gould-Modicon.

Modular I/O – I/O channels provided on a FloBoss using I/O modules. See I/O Module.

MPU – Micro-processor Unit.

mW – Milliwatts, or 0.001 watt.

mV – Millivolts, or 0.001 volt.

MVS – Multi-Variable Sensor. The MVS provides differential pressure, static pressure, and temperature inputs to the FloBoss 407 for orifice flow calculation.

N

NEC – National Electrical Code (US).

NEMA – National Electrical Manufacturer's Association (US).

O

OH – Off-Hook modem communications signal.

Off-line – Accomplished while the target device is not connected (by a communications link). For example, off-line configuration is configuring a FloBoss in a electronic file that is later loaded into the FloBoss.

Ohms – Units of electrical resistance.

On-line – Accomplished while connected (by a communications link) to the target device. For example, on-line configuration is configuring a FloBoss while connected to it, so that current parameter values are viewed and new values can be loaded immediately.

Opcode – Type of message protocol used by the FloBoss to communicate with the configuration software, as well as host computers with ROC driver software.

P, Q

Parameter – A property of a point that typically can be configured or set. For example, the Point Tag ID is a parameter of an Analog Input point. Parameters are normally edited by using configuration software running on a PC.

Pf – Flowing pressure.

PC – Personal computer.

P/DP – Pressure/Differential Pressure.

PI – Pulse Input.

PID – Proportional, Integral, and Derivative feedback control.

PIT – Periodic Timer Interrupt.

Point – Software-oriented term for an I/O channel or some other function, such as a flow calculation. Points are defined by a collection of parameters.

Point Number – The rack and number of an I/O point as installed in the FloBoss.

Point Type – The point type attribute defines the database point to be one of the possible types of points available to the system. The point type determines the basic functions of a point.

PRI – Primary PID control loop.

Protocol – A set of standards that enables communication or file transfers between two computers.

PSTN – Public switched telephone network.

PT – Process Temperature.

PTT – Push-to-talk signal.

Pulse – Transient variation of a signal whose value is normally constant.

PV – Process variable or process value.

R

Rack – Slots into which I/O modules may be plugged. A letter physically identifies an I/O channel location, such as “A” for the first rack. Built-in I/O channels are assigned a rack identifier of “A,” while diagnostic I/O channels are considered to be in rack “E.”

RAM – Random Access Memory. In a FloBoss, it is used to store history, data, most user programs, and additional configuration data.

RBX – Report-by-Exception. In a FloBoss, it always refers to Spontaneous RBX in which the FloBoss contacts the host to report an alarm condition.

RFI – Radio frequency interference.

RI – Ring Indicator modem communications signal.

ROC – Remote Operations Controller from the Flow Computer Division of Emerson Process Management, a microprocessor-based unit that provides remote monitoring and control.

ROCLINK or **ROCLINK 800** – Configuration software used to configure FloBoss units to gather data, as well as most other functions.

ROM – Read-only memory. Typically used to store firmware. Flash memory.

RTD – Resistance Temperature Detector.

RTS – Ready to Send modem communications signal.

RTU – Remote Terminal Unit.

RTV – Room Temperature Vulcanizing, typically a sealant or caulk like silicone rubber.

RXD – Received data communications signal.

S

SAMA – Scientific Apparatus Maker's Association.

Script – A uncompiled text file (such as keystrokes for a macro) that is interpreted by a program to perform certain functions. Typically, scripts can be easily created or edited by the end-user to customize the software.

Softpoints – A type of FloBoss point with generic parameters that can be configured to hold data as desired by the user.

SP – Setpoint, or Static Pressure.

SPI – Slow Pulse Input.

SPK – Speaker.

SRAM – Static Random Access Memory. Stores data as long as power is applied and typically backed up by a lithium battery.

SRBX – Spontaneous-Report-by-Exception. In a FloBoss, it always refers to Spontaneous RBX in which the FloBoss contacts the host to report an alarm condition.

SVA – Signal Value Analog.

SVD – Signal Value Discrete.

T-Z

TDI – Timed Discrete Input, or Timed Duration Input.

TDO – Timed Discrete Output, or Timed Duration Output.

Tf – Flowing temperature.

TLP – Type (of point), Logical (or point) number, and Parameter number.

TXD – Transmitted Data communications signal.

INDEX

Numerical

G

H

I

J

K

L

U

V

W-z

If you have comments or questions regarding this manual, please direct them to your local sales representative or contact:

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